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CIVIL ENGINEERING.

Contributions to Railway Statistics, in 1846, 1847, *and* 1848. *By* HYDE CLARKE, ESQ.

(Continued from page 5.)

No. 3.—*Coal Traffic.* Coal traffic is one of the largest and most important items of railway transit; but here, as elsewhere, the returns published by the Railway Department are insufficient to show the whole amount.—This is the more to be regretted, as the great reduction in the price of coal by railways has largely increased the demand for household use, as well as for manufacturing purposes. The monopolies of the canal proprietors, and of the wharfingers connected with them, have been broken up, and each year some new operation throws open a fresh district.

Coal traffic is of three kinds: from the colliery inland; from the colliery to the sea; and from the sea-shore inland.

The quantity enumerated amounts to about 8,900,000, or nearly 9,000,000; the number enumerated in 1845 being 7,000,000 tons.

The amounts received for the carriage of coals in the years ending June 30, 1846 and 1847, constitute a total of nearly £550,000, so that the gross total is most probably nearly £700,000, being the sum received by railways on account of the conveyance of coal. Among the lines omitted are the following:—Great Western, Edinburgh and Glasgow, Glasgow and Ayr, London and South Western, Eastern Counties—Colchester, Monkland and Kirkintilloch.

The rates of charge vary much on the several lines, depending on many circumstances, so that it is impossible to institute an accurate comparison. In some cases, the coal owners supply their own locomotives and wagons, and are charged with toll only. In others, they supply wagons only. In others, they are charged with an additional rent for wagons. In many cases the company hauls and supplies wagons.

Rate per ton per mile for toll only, and for total charges—

	Toll. *d.*	Total charges. *d.*
West Cornwall	—	5·82
Dunfermline and Charlestown	—	4·29
Bodmin and Wadebridge	—	4·00
Newcastle and Berwick, (North Shields)	—	3·50
Arbroath and Forfair	2·00	3·30
Cockermouth	—	3·11
Scotch Midland	—	3·07
Kendal and Windermere	—	3·00
Ballochney	—	3·00
Preston and Longridge	—	2·66
Furness	—	2·50
Maryport and Carlisle	1·30	2·47
Londonderry and Enniskillen	—	2·10
Wishaw and Coltness	1·60	2·03
Brighton	0·25	2·00
Slamannan	—	1·88
East Lancashire	—	1·85
London and South Western	—	1·77
Lancaster and Carlisle	—	1·75
Whitehaven	—	1·60
Edinburgh and Glasgow	—	1·50
Caledonian	—	1·43
St. Helen's	0·70	1·40
Llanelly	—	1·35
Ipswich and Bury	—	1·34
Shrewsbury and Chester	—	1·33
Bristol and Birmingham	—	1·32
Eastern Union	—	1·26
York and Newcastle	—	1·25
Newcastle and Carlisle	—	1·25
Glasgow and Greenock	0·81	1·25
Hartlepool	0·75	1·25
Taff Vale	0·66	1·16
Stockton and Hartlepool	—	1·06
Lancashire and Yorkshire	—	1·01
North British	—	1·00
Preston and Wyre	—	1·00
Eastern Counties (Cambridge)	—	1·00
Clarence	—	0·89
York and North Midland	—	0·75

On the whole, the rates for the carriage of coal are lower than they were in 1845; only a small quantity of coal is carried on the higher priced lines.

The following shows the quantity of coal carried in the year ending June 30, 1847, at each rate of charge:—

3*d.* and upwards	302,126 tons.
2*d.* and upwards	198,252 "
1*d.* and upwards	3,930,795 "
Under 1*d.*	629,416 "

Of the 3,930,795 tons carried at prices between 1*d.* and 2*d.*, 3,812,725 tons were carried at rates less than 1½*d.* per ton per mile. It will be seen that nearly all the coal carried by railway is carried for less than 1½*d.* per ton per mile.

The maximum charge for carrying coal is now 5·82*d.* per ton per mile, being on the West Cornwall or Hayle Railway. In 1845, the maximum charge was 6*d.* per ton per mile, being on the Canterbury and Whitstable railway.

Many of the Companies make no return of their charges for carrying coal, which is the more to be regretted, as the amalgamations have caused great alterations in the carrying rates.

The chief coal lines are the following:—

	1844–5. Tons.	1845–6. Tons.	1846–7. Tons.
York and Newcastle,	1,616,555	1,962,334	1,654,029
Stockton and Darlington,	900,000	904,358	911,645
Hartlepool,	796,486	893,701	789,673
Stockton and Hartlepool,	300,000	521,508	544,498
Midland,	492,420	395,325	481,344
London and North Western,	——	481,568	440,000
Caledonian,	——	227,183	335,319
Taff Vale,	125,066	284,066	314,621
St. Helens,	229,775	245,573	247,734
Glasgow and Ayr,	120,000	180,130	242,443
Newcastle and Carlisle,	205,500	190,068	236,649
North Union,	321,923	395,021	233,137

The Ballochney, Monkland, and other railways in the neighborhood, have a vast coal traffic; but, from the state of the returns, no calculations can be made as to its extent.

It cannot be said that the coal traffic greatly advanced in the year ending June 30, 1847. Though a great advance was made in the previous year, there seem to be in 1847 symptoms of the effects of the commercial crisis. A decline took place in the receipts of the York and Newcastle, and Midland, though an increase took place on the Stockton and Darlington, and Newcastle and Carlisle.

The coals conveyed by railway from the several fields are as follows:—

	1845. Tons.	1846. Tons.	1847. Tons.
Northumberland and Durham,	3,850,000	4,500,000	4,250,000
Cumberland,	200,000	135,000	190,000
Leicester, Nottingham & Derby,	300,000	300,000	370,000
Lancashire,	900,000	1,270,000	1,000,000
Yorkshire,	——	240,000	190,000
Briston,	50,000	90,000	100,000
South Wales,	220,000	380,000	400,000
Scotland,	760,000	1,650,000	2,100,000

It is impossible to separate the returns accurately, but it may be assumed that the quantity of coal carried by railway has increased in the Scotch and Cumberland fields. The produce of the Staffordshire fields cannot be separated.

The following shows the quantity of coals carried inland from the sea in each year:—

		1845. Tons.	1846. Tons.	1847. Tons.
Eastern Counties:	Cambridge,	——	15,000	15,000
"	Colchester,	20,000	26,976	20,000
"	Eastern Union,	——	——	16,000
"	Ipswich and Bury,	——	——	19,000
"	Norfolk,	——	6,000	15,000
South Eastern,		35,519	45,350	71,723
Brighton,		36,000	40,000	40,000
South Western,		4,000	18,830	31,659
London and North Western,		10,000	10,000	10,000
Cornwall,		28,000	30,065	33,545

The quantity of coal carried inland by means of railways has increased.

The saving in coal supplied to the city of York, in consequence of Mr. Hudson's railway measures, is not less than £30,000 yearly.

In the south-east of England, which is supplied mostly from the Northumberland and Durham coal field, the quantity carried upland by railway may be reckoned as follows:—

1845 - - - - -	120,000 tons.
1846 - - - - - -	162,000 "
1847 - - - - -	240,000 "

How trivial this is, may be seen from the quantity of coals imported into London, which is thus shown:—

1825 - - - - -	1,921,091 tons.
1835 - - - - - -	2,299,816 "
1845 - - - - -	3,461,199 "

It will be seen that in the supply of the inland districts the railways have proved very effective; but they have as yet done very little for those districts which are supplied from the sea. This must be attributed to the inability of the railway companies to give their attention at present to this branch of traffic; but when they do, a complete revolution must be effected in the supply of coals. The only lines from which we have detailed returns are the South Eastern and South Western, which show a great increase in the quantity of coal carried. There is every reason to believe that a great traffic is growing up in the Eastern Counties district—not less than 85,000 tons: but the returns do not show this fully.

No. 4.—*Coke Traffic.* The traffic in coke must be considerable in some districts, but there is a want of detailed returns. It is a lucrative branch of revenue to the Midland Railway Company.

The following shows the receipts for coke:—

	1846.	1847.
Midland - - - - -	£20,210	£24,198
Manchester and Bolton - -	16	——
Newcastle and Carlisle -	391	457
York and North Midland -	4,772	7,792

No. 5.—*Ironstone and Iron Traffic.* The rates charged for the conveyance of ironstone and iron ore are as follows:—

	Per ton per mile.
Ballochney	2·25*d.*
Newcastle and Carlisle	1·37
Taff Vale	1·16
Whitehaven	1·25
Wishaw and Coltness	2·23

The iron carried is mostly pig iron.

The rates for the carriage of iron are as follows:—

	Bar Iron. Per mile per ton.	Pig Iron. Per mile per ton.
Ballochney	3·00*d.*	1·66*d.*
Lancashire and Yorkshire	2·25	——
Maryport and Carlisle	——	1·80
Taff Vale	——	1·00
Wishaw and Coltness	——	1·84
Whitehaven	——	1·88

The traffic of the Glasgow iron district in coals, limestone, ironstone, iron dross, and slag, carried by railway was, in 1846 and 1847, as follows:

	1846.	1847.
Tons	2,500,000	2,900,000

The traffic of the Welsh iron district in coals, limestone, ironstone, and iron, stands as follows:—

	1844.	1845.	1846.	1847.
Tons,	242,000	323,000	396,000	441,000

The traffic of the Furness iron district consists solely in the shipment of ironstone to South Wales, to the extent of 106,301 tons in 1847.

No. 7.—*Limestone and Lime.* The quantity of limestone carried for agricultural purposes may be reckoned thus:—

District.	Tons.
Scotland	40,000
Northern	50,000
Yorkshire	25,000
Lancashire	25,000
Midland	50,000
Southern	20,000
Total	210,000

The rates for the carriage of a ton of limestone and lime per mile is as follows:—

	Lime.	Limestone.
Arbroath and Forfair	2·05*d.*	——
Llanelly and Llandilo	——	1·00*d.*
Maryport and Carlisle	1·50	1·30
Lancashire and Yorkshire	1·33	——
Newcastle and Carlisle	1·25	1·25
Slamannan	1·90	——
Wishaw and Coltness	——	1·35
York and North Midland	1·50	1·50

No. 8.—*Stone Traffic.* The total quantity of building and paving stones, limestones, and lime, carried on railways in 1847 was as follows, according to the enumerated returns:—

Building stones - - -	404,000 tons.
Limestones and lime - -	146,000 "
Total - -	550,000 tons.

The enumerated traffic gives the enormous amount of 550,000 tons of stones carried, but the whole quantity carried must be nearer 1,000,000 tons. Civ. Eng. & Arch. Jour., Sept. 1848.

(To be Continued.)

Railways through Europe.

The communication by rail is now either complete, or will soon be, *vid* Calais, right through the heart of Europe, including Paris, Brussels, Cologne, Antwerp, the Rhine, Berlin, Warsaw, Leipsic, Vienna, Switzerland, and Venice. Arrangements are already in progress for a grand continuous tour, or route, through most of the places here named. Paris itself will thus be approximated to London by a time distance of only eleven hours, or a run actually shorter than that to either of its own provincial capitals, Edinburgh or Dublin. Lond. Build. Feb. 17.

Report upon the Use of Anthracite Coal in Locomotive Engines on the Reading Railroad, made to the President of the Reading Railroad Company, by GEORGE W. WHISTLER, JR., *April* 20, 1849.

(Continued from page 12.)

The Comparison of Engines in their Cost for Repairs.

The most satisfactory comparison of the cost of maintaining Locomotive Engines, is that shown by a statement of the miles run during a certain period of time; but when Engines under comparison differ in their construction, for the purpose of developing some new mode of action, or, as in the case on the Reading Railroad, for the use of a new fuel, then a fair difference in their cost for repairs would be that excess caused by the use of one fuel as compared with the other, and also any excess in repairs caused by a mode of construction differing from that which is common, but necessary to the use of the new fuel.

The Reading Railroad has two distinct classes of Engines in the coal trade; the first and most numerous are the Engines burning wood, and of these there are several varieties, some on eight and others on six wheels, but all essentially alike, and the principal part of them were built at Philadelphia by Mr. M. W. Baldwin. The second class, burning anthracite coal, are few in number, and, with the exception of the Engine *Novelty*, were built at Baltimore by Mr. Ross Winans.

A description of these two classes of Engines has been given in the first part of this report, and it is only necessary to explain in what manner the

Baltimore Coal Engines differ from the eight wheeled wood Engines built at the same time and under the same specification, with a clause in the contract for the former, having reference to the burning of coal.

The essential point in which the Baltimore Engines differ from the wood Engines, is their having a much larger fire-place and area of grate for the combustion of coal; this increase of fire-grate was gotten by an addition made to the ordinary fire-box, and projecting back from that part of the fire-box immediately under the foot-board; this mode of construction threw the engine out of balance, for it was found that, of the twenty-seven tons weight (with coal and water) on eight driving wheels, 16·5 tons were on the four back drivers, and 10·5 tons on the four front drivers; to correct this disproportion of weight on the driving wheels, as well as to relieve the Engine of a portion of its adhesion, a small pair of trailing wheels were placed behind the fire-box, which bore two tons weight of the Engine, and also transferred two tons to the four forward drivers, thus balancing the Engine on its eight driving wheels, with twenty-five tons of adhesion. Of the Engines proper, cylinders, pistons, cross-heads, connecting rods, crankpins, frame, boxes, springs, wheels, valves, &c., there is no part of their construction which has any connexion with the burning of coal, and these parts differ from similar parts of wood Engines, as one builder differs from another, for reasons wholly independent of the boiler and its purposes; therefore the increased expenditure for repairs on account of the peculiar construction which is necessary to the use of coal, is confined in these Engines to the increased size of the fire place, and the small pair of trailing wheels for the support of its overhanging weight.

The principal item of excess in the cost for repairs of Engines burning coal over those burning wood, is caused by the destructive effects of a coal fire upon the inside sheets of the fire box; and when iron (the soundness of which is always uncertain from the manner in which it is at present made) has been used entirely for fire-boxes, this intense local heat has very soon blistered and burned away the sheets in the immediate vicinity of the coal fire. Another destructive effect from the use of coal is its severity on the laps or joinings of sheets in the fire place. To obviate this difficulty much larger sheets were used, but this again was found to increase the first evil, and finally, the uncertainty of procuring perfectly sound sheets of boiler iron of large size, (the difficulty of making them sound increasing with their size,) led to the abandonment of iron fire sheets for a distance of two feet above the grate, and the substitution of copper as a more certainly sound material.

The experience on the Reading Railroad with anthracite coal has developed a rapid and unexpected destruction to the copper fire sheets, from the mechanical action of the sharp particles of coal which flake off from the fresh coal when suddenly heated, and impinge upon and cut away the copper sheets forming the sides to the fire place. The occasional melting of grate bars, the increased liability to leakage, the wear and destruction to the ends of tubes by caulking, &c., and the accumulation and igniting of fine coal in the smoke box, all produce their share of extra expense for repairs, over wood-burning Engines.

In order to judge with some degree of accuracy of the use of anthracite coal in Locomotive Engines, when compared with the use of wood, as

well as in its effects upon the Engines, as the business of the road, I have given the date at which each coal Engine made its first trip upon the Reading Road, the number of trips made to the first of October last, and the miles run by each Engine during one year, estimated from the recorded trips; also the average number of miles run by the eight and six-wheeled wood Engines as shown by the report for 1847. Of the Baltimore Engines, the *Delaware* and *Maryland* had iron fire-boxes throughout, while the *Baltimore* and *Ohio* had copper sheets in their fire places, extending two feet above and one below the surface of the grate. The *Novelty*, during the time she has been upon the road, has had two boilers; the first boiler had an iron fire-box of very large dimensions, the second, made in the spring of 1848, also has an iron fire-box, but of smaller dimensions.

Tabulated Comparison of Engines on the Reading Railroad—Miles Run.

Name or Class of Engines.	First trip made over the road.	Trips made to September, 30th, 1848.	Miles run to September 30th, 1848.	Trips made from October, 1847, to October, 1848.	Average number of miles run in one year.	Coal hauled in one year—Tons.	Gross Load hauled in one year—Tons.
Baltimore . . .	June 18th, 1847.	251·0	23,845	194	18,430*		
Maryland	Sept. 4th, "	172·5	16,388	162	15,390*		
Delaware	" 12th, "	185·5	17,622	175	16,625*		
Ohio	" 22d, "	194·5	18,477	190	18,050		
Totals and Averages of the Baltimore Engines .	" 1st, "	803·5	76,332	180	17,124	40,500	81,000
Novelty . . .	June 17th, "	152·0	—	118	11,210	21,925	43,850
15 Eight-wheeled Engines,	—	—	—	—	21,129	46,700	93,400
19 Six-wheeled Engines,	—	—	—	—	17,517	34,575	69,151

* Time lost by renewing fire-sheets, included in the year.

The *Baltimore*, which came upon the road June 18th, 1847, completed her 251 trips in August, 1848, at which time she was brought into the shop to have the copper sheets in the fire place renewed, and did not commence her trips again upon the road till October 23d. The *Maryland* and *Delaware* each had their iron fire sheets renewed with copper, after seven months use. The *Ohio* has still, April, 1849, the original copper sheets in her fire-box.

By the foregoing statement, it will be seen that the *Baltimore's* copper fire place has lasted fourteen months; this is about one-third of the time experience had proved similar fire places to last in Engines burning bituminous coal upon the Baltimore and Ohio Railroad, and from which experience it was confidently expected that the copper fire places in Engines burning anthracite coal would last two years. The immediate cause of this speedy destruction on the Reading Railroad is the large quantity of fuel which is required to be burned in a given time, thus hastening the destructive effects of coal, as already explained, in proportion to the quantity consumed.

The extent of the destruction to fire sheets caused by the mechanical

action of the particles of coal is very limited, about fourteen inches in width through the entire length of the fire place, seven inches above and the same below the surface of the coal fire. In the line of the staybolts, both vertically and horizontally, the copper retains its original thickness, and upon the copper sheet immediately below the tube or flue sheet, there is no indication of wear, and none could take place from the causes just mentioned; for the particles of coal which are carried towards the tubes, bank against and protect this sheet. The melting of grate bars consequent upon the use of coal is quite uncertain, I have known whole sets to be destroyed as often as once a month; and again, with care, a single set to last several months. The principal causes which govern this waste are, the care bestowed by the firemen in keeping clear the fire-grate and ash-pan, and the nature of the coal used. If cinder is allowed to adhere and accumulate upon the grate, it will soon be destroyed; for the current of air is prevented that free access through all parts of the grate so necessary to its preservation. The neglect, however, to keep the ash-pan free from cinder and ashes, and when free, flooded with water to the depth of several inches, is the great cause of destruction to the grate bars. With bad coal, grate bars have melted by the accumulation of cinder which has taken place in a single trip; this, however, rarely occurs. The extra caulking of tubes, which is required by the use of coal, makes it necessary in time to remove the tubes, and to weld on new ends; some slight wear is also caused within a few inches of their ends by the mechanical action of the particles of coal, but producing no material injury.

I have thus stated the causes which produce the principal excess of repairs in Engines burning coal, over wood-burning Engines, and submit below an estimate of the entire extra cost of the *Baltimore coal Engines*, (so far as this cost for repairs relates to the burning of coal,) over the Engines burning wood upon the Reading Railroad of like power.

Cost per Engine for Renewing Fire Box.

800 lbs. Copper Fire-sheets, at 26 cents,	$208·00
110 " " Stay-bolts, "	28·60
65 " Iron " at 6 cents,	3·90
2½ days' work cutting stay-bolts, at $3,	7·50
7 weeks' work of two men removing old and renewing fire-sheets, at $10 per week,	140·00
7 weeks' work of two men, at $7 per week, at ditto,	98·00
	486·00
Deduct for 600 lbs. old copper, at 18 cents,	108·00
Cost for renewing fire-place,	$378·00

The *Baltimore's* copper fire-place was renewed after fourteen months' service, and if this be supposed the limit of durability on the Reading Road, it will involve an annual expense of $324·00

Deduct for depreciation of fire-box of wood-burning Engines in this time,	75·00
Remaining,	$249·00

Extra Cost per year over Wood Engines, for each Baltimore Coal Engine on the Reading Railroad, from the use of Anthracite Coal.

Cost for renewing fire place,	$249·00
3 sets of grate bars,—3225 lbs. cast iron, at 2½ cents,	80·64
Door plates, 500 lbs. cast iron, at 2½ cents,	12·50
Carried over,	$342·14

Amount brought forward,	$342·14
4 days' work of two men removing 50 tubes, at $1·75 and $1,	11·00
7½ days' work of two men welding new ends to tubes, at $1·75 and $1,	20·63
83 lbs. wrought iron for repairing tubes, at 6 cents,	4·98
3 days' work of three men caulking tubes, one man at $1·75, and two at $1 per day,	11·25
Extra work, caulking, &c.,	20·00
Work in smoke box,	35·00
1 set of trailing wheels, 300 lbs. cast iron, at 2½ cents,	7·50
1 day's work of two men fitting up ditto, at $2 and $1·50,	3·50
	$456·00

Experience proves that much unnecessary expense may be avoided in renewing the copper fire sheets of these Engines; for all that part of the copper which extends below the surface of the grate (thirteen inches) is entirely uninjured, and therefore does not require to be removed, and in estimating the necessary cost for repairs of these Engines, the item of copper may be reduced one-third, and in constructing Engines of equal power, a saving may be made in the original outlay, as sheets of copper twenty-five inches wide will be found quite sufficient for all purposes of protection from intense heat, for the water way in the fire-place need not extend below the grate further than is common, say one or two inches.

I have made no comparative estimate of the cost for repairs for the *Baltimore Coal Engines* and the coal Engine *Novelty;* the miles run during one year by these Engines is the most satisfactory that could be made.—The fire-place of the *Novelty's* boiler has proved quite as destructible as the fire-place of the *Baltimore Engines;* already several sheets have been renewed in the new boiler, after a few months' work; and I think it will be found, that although made uncommonly large, for the purpose of diffusing the local heat, its cost to keep in repair (when compared with the fire-place of the *Baltimore Engines*) will be found to increase in proportion to its size. In the destruction of grate bars, wear and tear of extra parts and machinery necessary to her coal-burning peculiarities, there can be no doubt of greatly increased costs over the *Baltimore Engines.*

Experience of the Baltimore and Ohio and other Railroads, in the use of Coal in Locomotive Engines.

It will be difficult to form any correct estimate of the value of anthracite coal as a fuel in comparison with wood, from any direct experiments that were made on the Baltimore and Ohio Railroad, from its earliest introduction in 1831, to its final abandonment for bituminous coal in 1840. The early reports of this company give a great many facts, and show most conclusively that this coal was used with entire success in all the Engines on the road, which, in 1840, numbered fifteen on the "Main Stem." The Engines were built with upright boilers expressly for the use of anthracite coal, and no experiments were made to test its relative value with wood. The company did not determine to use coal on the score of economy, for at the opening of the road, and for some time after, coal was $8 per ton, while wood did not exceed $2·50 per cord, the danger from fire, however, by the use of wood, but, more than all, the precedent of the English Railways then just coming into successful operation, which pointed to a mineral

fuel as seemingly the only fuel fit for Locomotive Engines, were the considerations which induced its use. In the spring and summer of 1840, however, an investigation was made of the relative values of anthracite and bituminous coal, by Mr. James Murray, then Engineer of Machinery on the Baltimore and Ohio Railroad; these experiment will enable a fair comparison to be instituted between anthracite coal and wood; for the oft repeated trials of bituminous coal with wood have established their equivalent quantities beyond a doubt.

To a more ready understanding of the facts which I shall present of the experience with fuel on the Baltimore and Ohio Railroad, and the application of these facts to the Reading Road, a short description of this road to its present terminus is given. The road is 178 miles long, but divided for working into two portions; first, from Baltimore to Harper's Ferry, 80 miles; second, from Harper's Ferry to Cumberland, 98 miles.

Baltimore to Harper's Ferry.

8	miles	rise from 30 to 40 feet per mile.
7	"	fall " 30 to 40 " "
2	"	rise at 82 " "
2	"	fall at 82 " "
46	"	rise and fall from 0 to 30 feet per mile.
15	"	level.
80	"	total length, with a total rise of 852 feet, and fall of 647 feet.
15	"	are curved with a less radius than 1000 feet. Total curvature, 31 circles of 360°.
80	"	of edge rail, 51 lbs. per yard.
30	"	of plate rail, 15 lbs. per yard, (portion of double track.)

Gross load for Engines weighing 23·5 tons—200 tons.

This load is regulated by the necessity for carrying it a portion of the distance on the plate rail. At the 82 feet grades assistant Engines are provided.

Harper's Ferry to Cumberland.

14	miles	rise from 30 to 40 feet per mile.
10	"	fall " 30 to 40 " "
33	"	rise and fall from 0 to 30 feet per mile.
41	"	level.
98	"	total length, and with a total rise of 998 feet, and fall of 634 feet.
1·6	"	are curved with a less radius than 1000 feet. Total curvature, 29 circles of 360°.
98	"	of edge rail, 51 lbs. per yard.

Gross load for Engines weighing 23·5 tons—275 tons.

The first successful effort to burn anthracite coal in Locomotive Engines was made upon the Baltimore and Ohio Railroad in 1831, by Phineas Davis, of York, Pennsylvania, in a small Engine built by him, having an upright boiler; the weight of this Engine was 3·5 tons, and was capable of transporting 15 tons at fifteen miles per hour. The same plan of Engines was adopted and adhered to for this road until 1838, with modifications and improvements from time to time; chiefly consisting in an increase of their weight, 12·5 tons being the maximum. These Engines are now

in successful operation, transporting merchandize and passengers, and show themselves quite equal to compete with those of larger and later construction. In 1833 the Engine *Atlantic*, weighing 6·5 tons, with 4 tons on the driving wheels, ran 13,280 miles, at 80 miles per day, with the consumption of 190 tons of anthracite coal. Gross load 23 tons. In 1834 the Engine *Arabian*, weighing 7·5 tons, on four driving wheels, consumed 1·25 tons of anthracite coal per trip of 80 miles. Gross load 45 tons. In 1840, when anthracite coal was abandoned for bituminous, a trial for two months was instituted in the same Engine, weighing 10·5 tons. Gross load 60 tons. This Engine ran to Frederick, distant 60 miles, and consumed 1 ton of bituminous coal to 1·25 of anthracite, and these results, I am told by Mr. Murray, held remarkably true throughout the trial. In 1840 and 1841, an accurate account was taken of the fuel consumed in eight wood and eleven coal-burning Engines. The wood-burning Engines weighed each 10 tons, with 6·5 tons on a single pair of driving wheels. The coal Engines weighed 9·75 tons on two pair of driving wheels.

8 Wood Engines, running 78,443 miles, consumed 2023 cords pine wood.
11 Coal " " 77,382 " " 1597 tons bituminous coal.
Wood consumed per trip of 80 miles with 40 tons gross load, 2·05 cords.
Coal " " 80 " " 60 " " 1·65 tons.
Proportion of coal to wood consumed per load taken, 1 ton to 1·87 cords.

No further additions were made to the stock of coal-burning Engines on the Baltimore and Ohio Railroad until 1844, the road then being open to Cumberland. In October of that year, Ross Winans produced the first successful coal-burning Engine with a horizontal boiler; for the Baltimore and Ohio Railroad, like the Reading Road, had made an unsuccessful effort to burn anthracite coal in an Engine built for them by Eastwick & Harrison, with a horizontal boiler, similar to the Engines furnished by the same parties to the Beaver Meadow and Hazleton Roads. Of the Engines built by Ross Winans, with horizontal boilers, six were placed upon the road between October, 1844, and July, 1845, and six others between July and December, 1846. One other Engine, substantially like these, but built by the company, was placed upon the road in May, 1847.—These thirteen Engines weigh each 23·5 tons, and have eight driving wheels 33 inches in diameter. Speed is attained through the medium of cog-gearing. The first six Engines were without copper fire-sheets, but renewed with copper after one year's service with the iron. The later built Engines were all constructed with copper fire-sheets.

The coal consumed by these Engines in 1845, was 3·25 tons between Baltimore and Harper's Ferry, with a gross load of 200 to 250 tons. In September and October, 1848, twenty-four trips were made with the same Engines on the upper or Cumberland end of the road, and thirty trips on the lower or Baltimore end of the road, for the purpose of testing the value of different coals. Average gross loads between Baltimore and Harper's Ferry, 200 tons, coal consumed, 2·25 tons per trip of 80 miles. Average gross loads between Harper's Ferry and Cumberland, 275 tons, coal consumed, 2·5 tons per trip of 98 miles. For a more ready comparison of the results which are known of the consumption of fuel on the Baltimore and Ohio Railroad, I have placed them in the following table:—

Table Shewing the Amounts of Fuel Consumed on the Baltimore and Ohio Railroad, at Different Periods from 1833 *to* 1848.

Date.	Weight of Engine on driving wheels.	Position of boiler.	Gross Loads.	Miles Run.	Fuel Consumed.
1833	4·00 Tons.	Upright.	23 Tons.	80	1·15 Tons Anthracite.
1834	7·50 "	"	45 "	80	1·25 " "
1838	8·50 "	"	50 "	60	1·50 " "
1840	10·50 "	"	60 "	60	1·25 " "
1840	10·50 "	"	60 "	60	1·00 " Bituminous.
1841	9·75 "	"	60 "	80	1·65 " "
1841	6·50 "	Horizontal.	40 "	80	2·05 Cords of Wood.
1841	19·33 "	Upright.	140 "	80	3·13 Tons Bituminous.
1841	8·25 "	Horizontal.	60 "	80	3·13 Cords of Wood.
1845	23·50 "	"	225 "	80	3·25 Tons Bituminous.
1848	10·50 "	Upright.	60 "	80	1·25 " "
1848	10·00 "	Horizontal.	60 "	80	1·03 " "
1848	10·00 "	"	60 "	80	2·75 Cords of Wood.
1848	10·00 "	"	60 "	80	1·58 Tons of Coke.
1848	23·50 "	"	200 "	80	2·25 " Bituminous.
1848	23·50 "	"	275 "	98	2·50 " "

1 Ton of Bituminous Coal = 1·25 Tons Anthracite Coal.
1 Ton of Bituminous Coal = 2·12 Cords of Wood.
1 Ton of Anthracite Coal = 1·75 Cords of Wood.

The cost for repairs of the large coal Engines on the Baltimore and Ohio Railroad, I am able to give with much accuracy; the annual reports furnish some of this information, but to Mr. Perkins, the Master of Machinery, I am indebted for details.

In 1847, the thirteen large coal Engines ran each 16,000 miles; in 1848, they ran 17,000 miles, and cost for repairs $1777 each; of this sum, however, a portion is due to the geared construction, which adapts them to the short curves of this road, but that which is due to coal-burning is as follows: Cost for renewing the fire-sheets of 23·5 tons Engines on the Baltimore and Ohio Railroad, after deducting for old copper, $300. Area of fire-grate, and amount of copper in fire-place, one-third less than Reading coal Engines. This difference in the amount of copper is not a necessary one, for the sheets of copper in the Reading Engines are wider, by ten inches, than the fire-sheets of the Baltimore and Ohio coal Engines, and do not extend above the grate a further distance.

In six of these large Engines, the copper fire-sheets were put in between November, 1845, and June, 1846, and one only has been renewed since; and, from their present appearance, there is no reason to doubt their lasting through this year. In giving the extra cost for repairs of these Engines, $100 per year is taken to cover the destruction to the fire-box.

Extra Cost per year, over Wood Engines, for each 23·5 *ton Coal Engine on the Baltimore and Ohio Railroad, from the use of Bituminous Coal.*

Cost for renewing fire place, ...	$100·00
2 setts of grate bars, 1000 lbs. cast iron, at 2½ cents, .	25·00
Renewing ends of tubes, caulking, &c., . . .	100·00
Extra work, caulking, &c., ...	25·00
	$250·00

In 1842, the Western Railroad Corporation of Massachusetts, purchased seven large coal-burning Engines of Ross Winans; these Engines were on eight driving wheels thirty-three inches in diameter, and geared for speed; weight of Engines, 20 to 23 tons; boilers upright; area of grate, 24 feet. In April of the same year, the Engineer of the Road, by an order of the Board, had trials made for five successive days with the Engine *Maryland*, weighing 20 tons, for the purpose of ascertaining the quantity of fuel consumed. These trials were made on that portion of the road between Albany and Springfield, distance 100 miles. In running 500 miles with fair loads due to the adhesion, the consumption of fuel (anthracite coal) was 2·5 tons per trip of 100 miles. The large wood-burning Engines on that road, weighing 20 tons, with 14 tons on four driving wheels, (when drawing their load,) consumed four cords of wood per trip of 100 miles. This comparison of wood and coal shows 1 ton of anthracite coal to be equal to 2·26 cords of wood; a comparison more favorable to anthracite coal than any I know of. The upright boiler, however, of these Engines, with their large area of grate, were well adapted to burn anthracite coal; while the hemlock wood used on this portion of the Western Railroad was an inferior fuel to the mixture of pine and oak common in this section of the country.

The use of anthracite coal was continued in these Engines until the close of the year 1842, when, from motives of economy, (cost of coal $7 per ton, and wood $3 per cord,) and to ensure greater regularity on a long line of road, with a single track and a heavy business, (which the want of experience in the use of this fuel in some degree prevented,) coal was abandoned for wood. As wood-burners, these Engines were not economical; and as the upright boiler was a source of considerable expense, owing to the sediment which collected on the tube-head, they were, in 1846, placed in ordinary and other Engines substituted on the road.

The Beaver Meadow Railroad is fourteen miles long from the foot of its inclined planes, where it is intersected by the Hazleton Railroad, to its terminus at Mauch Chunk. The grades of this road are eighty feet per mile, till it strikes the Lehigh river, distant five miles; and from this point to Mauch Chunk (nine miles) the road falls with the river from twenty to fifty feet per mile; it has short curves and is laid with a light plate rail.

There are six Engines on the road burning anthracite coal, they weigh about fourteen tons, with ten tons on four driving wheels. The first Engine was placed upon the road in 1837, and was built by Garrett, Eastwick & Co. Loads for engines up the grade, forty-five tons gross, exclusive of Engine and tender (seventeen tons). The work is done upon this portion of the road with three Engines, each running daily seventy miles during twelve hours, and the fuel consumed is about 2·75 tons of anthracite coal per Engine. Gross load per round trip of 28 miles, 230 tons.

The Hazleton Railroad, from Hazleton to its intersection with the Beaver Meadow Road, is nine and a half miles long, and from this point to the Lehigh river at Penn Haven, (five miles,) the Beaver Meadow Railroad is used in common by the two companies. The grades upon the first four miles of the road from Hazleton are light; then descending at sixty feet per mile for four miles; and then at one hundred and forty feet per mile for one and a half miles, to its intersection with the Beaver Meadow Road;

the loads up the one hundred and forty feet grade are divided. The remaining five miles over which the Hazleton Company carry their coal, falls at eighty feet per mile to the Lehigh river. Road laid with plate rail and short curves. Engines similar to those on the Beaver Meadow Road; first one went to work in 1839. Number of Engines at work each day, loads taken, miles run, and fuel consumed, same as Beaver Meadow Road.

The cost for repairs of Engines on these two last-named roads, I am not able to give; but as experience shows that the fire-boxes (which are of iron) last from five to six years, the extra cost for repairs due to the use of anthracite coal would appear very immaterial. There are, however, considerations which should be taken into account in judging the value of the results in the use of coal on these roads. During the three winter months, these roads are not worked, and the amount of fuel consumed is about two-thirds of that consumed in the Engines on the Reading Road in the same working time. The short run (not exceeding fourteen miles) also enables a thin fire to be kept, which is cleared of cinder at each end of the road, while the Engine is being turned and attached to its return load; but, before starting, it becomes necessary to replenish the fire-place with wood, and thus a new fire is kindled every few hours in the day. This system is quite practicable on roads where the consequent delays are not felt, but entirely inapplicable to the Reading Road.

To be Continued.

Report to the President and Directors of the Ohio and Pennsylvania Railroad Company. By Solomon W. Roberts, *Chief Engineer.*

Continued from page 21.

From Mount Union to Canton, Massillon, Wooster, and Mansfield.

From Mount Union to Wooster the distance is 50 miles, and the road will open a country which, for the production of wheat, is, perhaps, unequalled in America. It runs through the heart of Stark and Wayne counties, passes by the important town of Canton, the county seat of Stark, and, at the distance of 101 miles from Pittsburg, crosses the Ohio canal at Massillon, the great wheat mart of Ohio.

As the immense trade of Massillon has always sought the New York and Boston markets, it strikes the minds of most persons with surprise when they are first informed that the place is only 101 miles from Pittsburg.

By official returns, it appears that in 1847 there were shipped, at Massillon, upon the Ohio canal, the almost incredible amount of 1,489,697 bushels of wheat; besides 55,669 barrels of flour; 45,139 bushels of corn; 202,719 pounds of wool; 73,889 pounds of leather; and 37,388 pounds of eggs.

The whole amount of flour and grain shipped coastwise from Cleveland, in 1847, was 2,066,484 bushels of wheat, and 701,870 barrels of flour.

The arrivals at Cleveland by the Ohio canal, in 1847, were 644,913 barrels of flour and 2,130,317 bushels of wheat; and there were cleared at

that port upon the canal, in the same season, upwards of *fifteen millions* of pounds of merchandize.

At the town of Akron, about twenty-five miles north of Massillon, where the "Pennsylvania and Ohio Canal" ends, the shipments were 231,221 barrels of flour, and 589,376 bushels of wheat.

If any one will attentively consider the statistical returns of the production and shipment of produce in Ohio, he cannot fail to see that our line runs *through the heart* of that region which raises the largest supply of the "staff of life." We need no long branches to reach it, but we pass right through it. It is the granary of the State; and, while it is a grain region, it is also a coal region. The country south of the Sandy and Beaver Canal is much more hilly and greatly inferior in its surplus productions.

Salem contains a remarkably enterprising and thrifty population of about 1500; and Canton, Massillon, and Wooster, are flourishing and improving towns of about 3000 people each. Our "back-bone line," passing through them, will benefit them more than could possibly be done by any other enterprise.

Canton is the county town of Stark, and Wooster of Wayne county. Stark stands *first* in the list of the counties of Ohio for the production of wheat; the amount raised in 1840 having been 753,977 bushels; and in 1846 it reached 989,808 bushels. No doubt it now much exceeds a million.

The amount given in the statistical tables, in 1840, was, for Wayne county, 753,621 bushels, and it stood *second* in the list; while Columbiana raised 435,834 bushels of wheat, being the eighth in order; but it stood *first* for the production of wool, and raised 215,426 pounds.

The remaining county on our line is Richland, Ashland having been recently formed. The county town of Richland is Mansfield, 164 miles from Pittsburg by our railroad. The wheat raised in the county in 1840, was 506,585 bushels, and the amount of other productions was large.

The *population* of the four counties, in 1840, stood as follows: Columbiana 40,378, Stark 34,603, Wayne 35,808, and Richland 44,532; making an aggregate of 155,321. Omitting Hamilton county, which includes the city of Cincinnati, *Richland stands first in population among the counties of Ohio, and Columbiana second.*

These facts show the character of the country through which our line passes; they show that the *local trade* along it will justify its construction; and that we may safely and proudly challenge a statistical comparison with any line of equal length that can be drawn westward from the eastern boundary of Ohio.

These counties have greatly increased in population and wealth since 1840, and their present valuation of taxable property is about thirty millions of dollars.

To complete and bring into successful use a good railroad, with a heavy iron track, from Pittsburg to the point of intersection with the Columbus and Cleveland road, twelve miles west of Mansfield, a distance of 176 miles, will probably cost about three millions of dollars.

In view of the importance of the work, and of the trade which it will command, the use of a heavy iron track is, in my opinion, essential. Such a track costs about ten thousand dollars per mile.

At Mansfield we connect with the Mansfield and Sandusky City Railroad, 56 miles in length, which was opened for use in June, 1846. In 1847, that road carried 504,081 bushels of wheat, 62,598 barrels of flour, with a large amount of other articles; and its *net earnings* were $61,406·03.

The Directors, in their Report, say: "The construction of this road has given an impetus to Mansfield and the surrounding towns, together with the towns upon the line of railroad, and to Sandusky city, which far exceeds the estimate made three years ago by our most sanguine friends." "It has also created an interior market for the farmer, and, on an average, *has doubled the value of his surplus products*, and made such marketable as were not of cash value before; has cheapened all that he consumes, in the line of staples and domestics, one-half their former cost, and has greatly increased the value of real estate, where its effects have been felt."

Similar results have attended the construction of the Little Miami and Mad River Railroads, and all these works are highly profitable investments. The *net earnings* of the Little Miami Road, in 1848, were $146,072·48, being ten per cent. on the capital stock. Similar results may confidently be predicted upon our road.

A very extensive and elaborate series of surveys has been made between Wooster and Mansfield, a distance of about 39 miles. Three routes, with a number of subordinate lines, have been examined, each of which routes has peculiar advantages, especially with reference to the accommodation of local interests; and all the facts bearing upon the question should be fully reviewed and considered by the Board before a determination is made.

But whatever conclusion may be come to on this subject, it is clear to my mind, that the importance of a connexion between Wooster and Columbus, by the way of Mount Vernon, should never be lost sight of. With that connexion once secured, we shall be in a position to compete successfully for the Cincinnati travel with any other road that can be made between Pittsburg and Cincinnati; the whole distance between those cities being 330 miles, by a route passing through a country of unparalleled productiveness. This connecting link will be of vast advantage to the citizens of Mount Vernon, and of Knox county; the distance from Wooster to Mount Vernon being 47 miles, and thence to Columbus 40 miles. Should the southern route between Wooster and Mansfield be adopted, but little over 20 miles of road will complete the connexion with Mount Vernon.

Our line, running out westward over the table lands to Wooster, and thence turning south-westward in the direction of Columbus, runs nearly parallel with the Sandy and Beaver and the Ohio Canals, but at a distance from them, and is much straighter than they are, not being confined in crooked valleys. Our railroad route from Pittsburg to Columbus is 25 miles shorter than the river and canal boat route by Glasgow, Bolivar, and the valley of the Tuscarawas to Newark, combined with the proposed railroad from Newark to Columbus. We run through the heart of the rich farming region, having a tributary country on both sides, and we do not come into direct competition with any canal or other public work already constructed.

One of the great advantages of a railroad is that, unlike a canal, it need not seek large supplies of water or the lowest levels. It need not be ex-

posed to inundations, and, by establishing its depôts in the richest districts of the country, it saves to the producer a large part of the expense which he must otherwise incur in hauling his produce to water communications.

A bushel of wheat, when taken from Massillon to New York by the usual canal, lake, and river communication, is carried 770 miles, and a long period elapses before returns can be received. By our railroad route, the distance from Massillon to New York will be 547 miles, and to Philadelphia 459 miles, and returns can be received without delay. On the Boston and Albany Railroad vast quantities of flour are carried, with great promptness, 200 miles, for thirty cents a barrel. The railroad being open twelve months in the year, while the canal is open but eight, the former has an advantage over the latter of fifty per cent. in the period of its usefulness.

The country around Rochester is emphatically the wheat region of New York, as that around Massillon is the wheat region of Ohio. The New York wheat-grower now has an advantage of about 350 miles over his Ohio competitor in transportation to the eastern markets; which, with a winter communication to Boston, makes his produce worth twenty per cent. more; but the construction of our road will put them, as nearly as may be, upon a par in distance to the seaboard, and also in the possession of a winter communication.

The Importance of the "Ohio and Pennsylvania Railroad," as a part of the General System of Railroads in the United States.

Internal improvements are among the main elements of the commercial power of a nation. When they are wisely and well executed they confer upon it vast advantages and lasting honor. Their moral benefits go hand in hand with those of a commercial character; and railroads especially, by facilitating personal intercommunication, break down the barriers of prejudice, and bind together in a common bond the citizens of the most widely extended communities. Those works, by which we achieve our peaceful victories over space and time, become enduring monuments of the intelligence of the generation by which they were planned and constructed.—Practically, they lengthen life, for they enable more to be done in the same period; and they quicken and facilitate the movements of those whose high mission it is, in various ways, to instruct and to improve their fellow men. It has been well said by Macauley, in writing the History of the Progress of England, that next to the alphabet and the printing press, those inventions that abridge distance have done most for the civilization of our species.

When we look upon a map of the United States, we are struck with the position of the State of Pennsylvania. With its eastern border washed by the tide-waters of the Atlantic, it stretches westward to the head of the Ohio river at Pittsburg, and to the shores of Lake Erie. No other State combines these advantages. Directly west of Pennsylvania are the great grain-growing States of Ohio, Indiana, and Illinois, and their shortest route both to Philadelphia and New York lies through her territory.

For a series of years the State of Pennsylvania enjoyed the advantages of her geographical position by means of a system of turnpikes. But the opening of the Erie Canal, of New York, in 1825, changed the face of

affairs, and transferred the advantages of the western trade to that State. In the following year Pennsylvania began her canal system, but the Allegheny range divided her territory, and prevented her canals from being continuous.

In 1830, land carriage received its most signal improvement by the successful opening of the Liverpool and Manchester Railway in England. By the combination of the fire-tubes with the blast-pipe, the "Rocket" engine became the parent locomotive of an innumerable race; and this invention, combined with that of rolled iron railroad rails, created a new era in inland transportation.

The legislature of Pennsylvania, at its next session, determined to take advantage of the new improvement, for the purpose of uniting her canals by scaling the Alleghenies, and, in the spring of 1831, the writer of this Report was appointed to lead the exploring party in locating the Allegheny Portage Railroad.

Although that road was made in the infancy of the railroad system, its opening, in 1834, was of vast advantage to the State and to the Union. But the line between Philadelphia and Pittsburg, being made up of an alternate system of canals and railroads, is attended with many disadvantages, and burthened with the expense of repeated transhipments. These evils will speedily be remedied by the Pennsylvania Railroad, now in course of construction, in the best manner, and with the aid of all the lights of the experience of the past.

Following nearly the fortieth parallel of north latitude, the dividing line of the population of our country, it will be the "*Central Railroad*" of the Union, and the Ohio and Pennsylvania Railroad, or "back-bone line," will be its extension westward from Pittsburg over the fertile plains of Ohio.

In 1788, Ohio was a wilderness, with no permanent white population. Since 1830, its population has increased, in round numbers, from one to *two millions of people;* and the great free States, to the west and northwest of it, have increased, and are increasing, in population and wealth with unexampled rapidity.

The charter of the Ohio and Pennsylvania Railroad Company is of the most liberal character, and will enable the Directors to pursue the policy best adapted to add to the value of the stock, and to protect and promote the interests of the stockholders; which is the only safe policy for such a Corporation.

Neither the time for the completion of the work, nor its western terminus is fixed by law, and, under its charter, this Corporation may either extend its operations to the western boundary of Ohio, or may content itself with connecting with some of the other railroads in the western part of the State. Our surveys have been extended to Bucyrus, the county town of Crawford county, 24 miles west of Mansfield, which is an important point; but it would be premature, at this time, to express an opinion as to the relative importance of the various extensions of our road beyond Mansfield, which will, sooner or later, be made.

By connecting with the Mad River Railroad at Kenton, we may obtain a connexion with Cincinnati, making the distance from Pittsburg about

360 miles; or nearly the same as that by the intersection of the Columbus road beyond Mansfield, and about 30 miles more than by the cut off connexion from Wooster to Mount Vernon and Columbus. Our road will thus intersect three lines leading to Cincinnati, besides being connected with Newark by the Mansfield and Newark Road, now nearly completed.

The railroad distance from Kenton to Bellefontaine is 24 miles, and at that point comes in the important road now in progress of construction, from Bellefontaine to Indianapolis, a distance of 140 miles, 83 of which are in Indiana. There is a railroad now in use from Indianapolis to Madison, a distance of 86 miles, which makes dividends of *fourteen per cent.* per annum, and the stock of which is much above par.

From Indianapolis to St. Louis, by the general route of the National Road, crossing the Wabash at Terre Haute, will be about 250 miles, passing through a highly productive country, and making the whole distance from Philadelphia to St. Louis about 990 miles. A more northerly line from Kenton westward, crossing the Wabash at Lafayette, is also projected.

The present importance of St. Louis need not be dwelt upon, and one of the proposed railroads to the Pacific will probably start from that point.

The Ohio and Pennsylvania Railroad will not only command a greater amount of local trade and travel than any other road in Ohio, stretching in the same direction, can do, but it will afford excellent connexions with Cincinnati and St. Louis, by lines running through the most populous parts of the country.

Combined with these advantages, it has, in addition, the remarkable characteristic of forming a part of the best railroad connexions with Cleveland, Sandusky, and Toledo, on Lake Erie, and, by means of the "Ohio, Indiana, and Lake Michigan Railroad," with the city of Chicago, and the vast and growing empire of the north-west. This includes northern Indiana and Illinois, and southern Michigan; and, by means of the Chicago and Galena Railroad, the States of Wisconsin and Iowa, the Territory of Minesota, and the wide expanse of territory still further west. The distance from Philadelphia to Chicago will be about 850 miles.

To my mind it is clear that the inducements to capitalists, and the prospects of benefit to the public, presented by the "Ohio and Pennsylvania Railroad," or "back-bone line," can scarcely be surpassed.

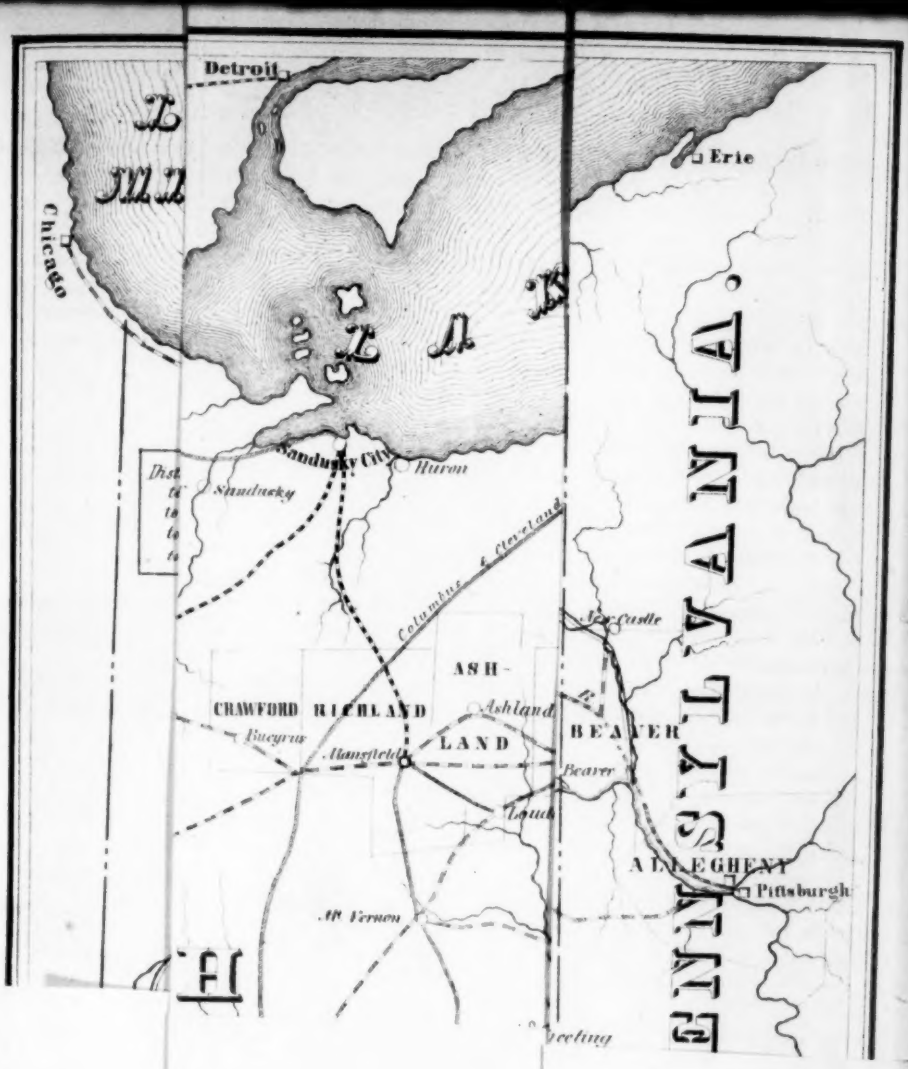
In concluding this Report, it gives me pleasure to express my entire satisfaction with the manner in which the Resident Engineers, Mr. Jesse R. Straughan and Mr Edward Warner, have fulfilled their duties. They have shown themselves to be gentlemen well worthy of the trust which has been confided to their care.

The outline of this, my first Report as Chief Engineer of the Ohio and Pennsylvania Railroad Company, based upon the preliminary surveys, was drawn up at Pittsburg, in January, 1849.

Respectfully submitted,

SOLOMON W. ROBERTS,

Civil Engineer.



springs the trap

AMERICAN PATENTS.

List of American Patents which issued in the month of September, 1848, *with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents, in the U. S. Patent Office.*

1. For an *Improvement in Calculating Machines;* J. J. Baranowski, of the Empire of Russia, September 5; in France, 25th November, 1847.

The patentee says,—"My invention consists of a commercial table or ready reckoner, containing the various results previously calculated and arranged, consecutively in units, tens, hundreds, &c., as well as in fractional parts when desired; of suitable apparatus for bringing the numbers of such table into view; of a face plate with openings formed in it, to admit of any portion of such commercial table or ready reckoner being seen when required; and lastly, of a number of accurately filled slides, any number of which can be withdrawn for the purpose of exhibiting the numbers constituting the required result; the other numbers not required for the result to be ascertained being concealed from view. The slides and the face plate are so adapted and arranged, that the operator may readily see from the front of the machine which slide to withdraw, in order to disclose any result required."

Claim.—"What I claim as my invention, is a ready reckoning machine, constructed and arranged substantially as set forth, so that commercial tables or ready reckoners may be used and read for the purpose for which they are intended, by bringing into view, by a simple mechanical operation, such of the symbols or numbers only as are necessary for, or form part of, the particular calculation or result to be ascertained, the rest of the numbers on the table being at the same time concealed from view."

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2. For an *Improvement in Cutting Veneers into Figures;* Joseph Fielemeier, Philadelphia, Pennsylvania, September 5.

Claim.—"What I claim as my invention, is, 1st, The combination of the clamp plates, for holding the veneers, with the cutters and the block or stock to which they are attached, as set forth.

"2d, I claim the combination of the movable plates and screws, for operating the clamp and cutters, with the fixed head and arms, secured to the base or platform by the combined posts and vertical guides, as set forth.

"3d, I claim the combination of the leaden, iron, and wood plates with the steel spring cutters bedded into the leaden plate, as set forth."

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3. For an *Improvement in the Method of Setting Steel Traps;* Warren Jenks, Schroon, Essex county, New York, September 5.

The patentee says,—"The nature of my invention consists in causing both of the hooks made fast to the trap to be thrown forward by the spring, either in a horizontal or perpendicular direction, so that when the animal springs the trap by taking the bait on the middle hook, the lower hook

miles; or nearly the same as that by the intersection of the Columbus beyond Mansfield, and about 30 miles more than by the cut off con- on from Wooster to Mount Vernon and Columbus. Our road will intersect three lines leading to Cincinnati, besides being connected Newark by the Mansfield and Newark Road, now nearly completed. he railroad distance from Kenton to Bellefontaine is 24 miles, and at point comes in the important road now in progress of construction, Bellefontaine to Indianapolis, a distance of 140 miles, 83 of which n Indiana. There is a railroad now in use from Indianapolis to Madi- a distance of 86 miles, which makes dividends of *fourteen per cent.* annum, and the stock of which is much above par.

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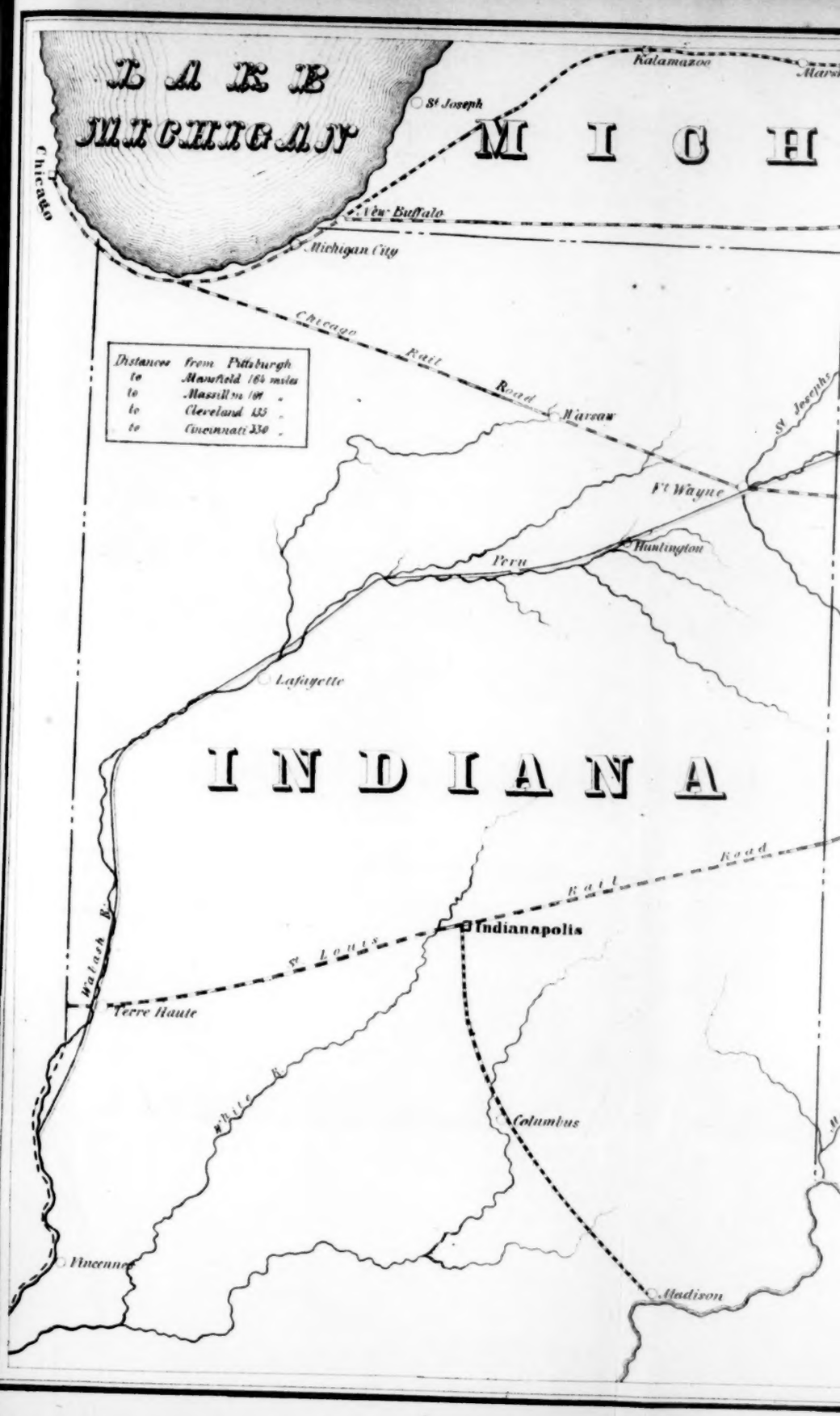
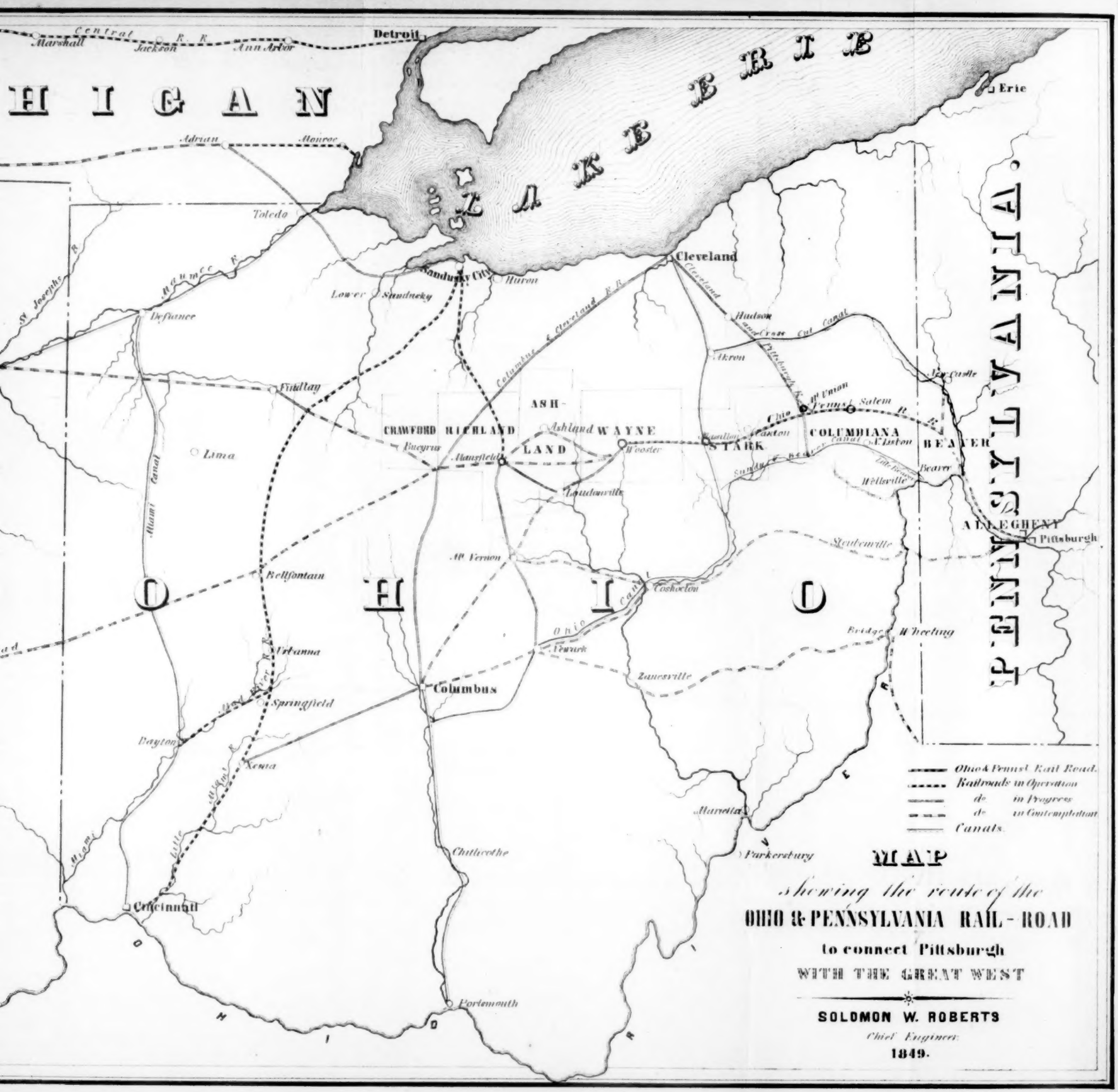
Civil Engineer.

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Wheeling
Bridge
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Columbus
Springfield
Zanesville
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OHIO R.
Ohio & Penns. Rail Road.
Railroads in Operation
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Canals.
MAP
Showing the route of the
OHIO & PENNSYLVANIA RAIL-ROAD
to connect Pittsburgh
WITH THE GREAT WEST
SOLOMON W. ROBERTS
Chief Engineer.
1849.

will be forced into the throat beneath the under jaw, and the upper one into the head or neck on the upper side, thus penetrating until they meet at the points; or, if sprung by passing over it, that the hooks will be forced into the body of the animal on each side."

Claim.—"What I claim as my invention, is the form of the hook, and the manner of setting the trap by the use of said hook, constructed and operating substantially as set forth."

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4. For an *Improvement in Compound Rail for Railroads;* Benj. H. Latrobe, Baltimore, Maryland, September 5.

The patentee says,—"My rail is composed of three parts, by which I secure an approximation to a uniformity of strength in the combined bar, by breaking the joints at two points instead of one, which is all that can be effected by the former modes; and it can be applied in many cases where the other could not."

Claim.—"What I claim as my invention, is the combination of the cap rail and base rails, substantially in the manner and for the purposes set forth."

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5. For an *Improvement in Ploughs;* John Ormiston, Waterford, Washington county, Ohio, September 5.

Claim.—"What I claim as my invention, is, 1st, The combination of the notched plate and slotted hook stop, for adjusting and holding the point, and the manner in which the point passes through the front piece, and is regulated by the notched plate and dog or stop; and in combination therewith, I claim the tubular nose, made with a flanch or cutter, as set forth."

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6. For an *Improvement in the Portable Lock;* Alonzo Perry, City of New York, September 5.

The patentee says,—"The nature of my invention consists in the construction of a lock to be used generally in the place of a common padlock, the said lock forming the clasp or strap itself, with neat screw connexions or fastenings instead of staples; the lock to be used as a wrench to insert the catch in its proper place, as well as to fix the screw with which it is connected at its butt into the door post or frame."

Claim.—"What I claim as my invention, is the combination of the fast and loose screw fastened with the lock, so arranged that the lock itself may be used as a wrench to insert the screws or fastenings of said lock into the door or post as the case may be, the whole to form a portable lock in the manner set forth."

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7. For an *Improvement in the Self-Acting Railroad Switch;* Edward J. Stearns, Ellicott's Mills, Ann Arundel country, Maryland, September 5.

The patentee says,—"The nature of my invention consists in so arranging one end of a self-adjusting railroad switch, that the manager or engineer of a locomotive, or any other railroad car, may direct the train from the

main track to a branch track, by moving a lever attached to the locomotive or cars, and in so arranging the other end of the switch that it may be operated by the flanches of the wheels when passing from the branch to the main track, or otherwise."

Claim.—"What I claim as my invention, is the application and hanging of the switch-rail, so as to turn horizontally on a pivot, as set forth, in combination with the horizontal lever beneath the flat plate, and the spring acting upon it, and through it, upon the switch rail, and thus keeping the switch-rail pressed against the narrow end of the tapering rail, when the cars are not passing through; also, in combination with the tilting frame below, and the flanch levers resting upon it at one end, and the crowning levers at the other, and the arranging of these latter levers so as to arrest the long arm of the one or the other of the horizontal levers, and thus hold fast the one or the other of the switch-rails, according as the one or the other side of the tilting frame is depressed by a movable lever attached to the locomotive or car, pressing on the one or the other of the crowning levers in going towards the turnout, or by the flanch levers at the other end of the frame in coming back on the one or the other track, as set forth."

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8. For an *Improvement in Axletrees;* Jonathan W. Whitney, Buffalo, Erie county, New York, September 5.

Claim.—"What I claim as my invention, is the combination of the cross standards with the axle, straining bar, and adjusting screws, substantially as set forth, for the purpose of accurately adjusting and gauging the track of the wheels, by giving to the points of the axles more or less inclination, the lower spokes of the wheels being thus kept in a perpendicular or inclined position as may be preferred."

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9. For an *Improvement in the Apparatus for Stretching and Drying Cloth;* E. B. Bigelow, Boston, Suffolk county, Massachusetts, September 5.

The patentee says,—"The nature of my invention consists in the employment of an endless chain of tenter hooks, for stretching and drying cloth over a series of steam pipes, or by air heated in any convenient way, instead of stretching the cloth on the stationary frames for that purpose, as set forth."

Claim.—"What I claim as my invention, is the endless chain of tenter hooks, constructed substantially as set forth, for conveying the cloth over the drying apparatus in the manner set forth.

"2d, I claim, in combination with the above, the series of steam pipes, or other equivalent device for drying the cloth as it is made to pass over them, as set forth.

"3d, I claim, in combination therewith, the steam cylinder for completing the operation when required, as set forth.

"4th, I claim the method of stretching the fabric on the tenter hooks, by causing the endless chain to be separated from each other as they move forward, as set forth.

"5th, I claim the employment of the wheels for fixing the cloth into the tenter hooks, as set forth."

10. For an *Improvement in the Cultivator Point;* Robert Criswell, Jr., Chambersburg, Franklin county, Pennsylvania, September 5.

Claim.—"What I claim as my invention, is the giving the sides of a cultivating shovel point, the one a forward, and the other a rearward curve, substantially for the purpose set forth."

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11. For an *Improvement in Pulp Machines for the Manufacturing of Paper;* Geo. Sweetland, New Haven, Connecticut, September 5.

The patentee says,—"My improvement consists in constructing a cylindrical vat, of suitable dimensions for the extent of the work intended to be done, with a circular curve near the bottom, extending about one-fourth of the diameter towards the centre of the cylindrical vat on all sides, or entirely round the lower part of the vat."

Claim.—"What I claim as my invention, is the combination of the bed and worker with their cutters, arranged horizontally in the bottom of a cylindrical vat, so as to cut or grind rags, straw, and other materials, (for making paper of every description,) into pulp of any even and suitable quality, by carrying the material in water through the machine, by means of the centrifugal force which is communicated to the water by the horizontal rotary motion of the worker, by which centrifugal force the water will be raised against the sides of the cylindrical vat, whence, by its own gravity, it will flow down to the centre, and through the hole or eye in the stationary wheel or bed, down to the worker, thereby keeping the material always loosely diffused through the water, and flowing with it through the machine continually, until the pulp is fit for use; the whole constructed, arranged, combined, and operating as set forth."

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12. For an *Improvement in the Mode of Incorporating Flocks with Flannel, &c.;* John M. Pratt, Dudley, Worcester county, Massachusetts, September 5.

Claim.—"What I claim as my invention, is the principle or mode of putting flocks into flannels and other cloths by means of rubbing them in with a cylinder and slats; and also the principle or mode of causing the flocks to fall on to the cylinder in even and uniform quantities, by means of the flock box and picker."

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13. For an *Improvement in Door Locks;* William Stephenson, Cincinnati, Hamilton county, Ohio, September 12.

Claim.—"What I claim as my invention, is, 1st, The application of a vibrating guard plate, in connexion with a yoke attached to the outer plate of the lock, constructed and operating substantially as set forth, so as effectually to close the keyhole of any lock on the outside, when locked on the inside, by the application of the key.

"I also claim the manner of constructing, arranging, and operating, substantially, the case for the key, with the spindles in said case, in connexion with opposite keyholes on each side of the lock, so that the key can be inserted from either side of the lock, and slipped over the same spindles,

and when withdrawn from the outside of said lock, said spindles shall prevent the lock from being picked, as set forth."

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14. For an *Improvement in Machines for Cutting Bungs;* Josiah Kirby, Cincinnati, Hamilton county, Ohio, September 12.

Claim.—"What I claim as my invention, is the application to making plugs for covering the heads of screws, nails, bolts, &c., used in ship building and other work, and plugs and bungs for barrels, of a cutter or hollow chisel, made so as to fit into a mandril by screw or otherwise, and bored out at the mouth to any given size, straight up far enough for the depth of a plug or bung, or to a given distance, then tapering into the centre so as to point the plug by compressing the end of the wood, a hole being bored through the whole length of the cutter, so as to admit a rod through to drive out the plug when cut. I also claim the application to making plugs and bungs of the combination of the mandril, cutter, driving rod, and separator, as set forth."

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15. For an *Improvement in the Machine for Dressing Wooden Chair Seats;* Isaac Baker, Warwick, Franklin county, Massachusetts, September 12.

Claim.—"What I claim as my invention, is the mechanical method set forth of cutting the top faces of chair bottoms: that is, by a feeding frame having convex and concave guides, as set forth, and operating as set forth, in combination with a cylinder of curved knives and pressure rollers, arranged so as to move up and down as set forth, the whole mechanical arrangement being substantially as set forth."

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16. For an *Improvement in Knitting Loom Needles;* William Bamford, Ipswich, Essex county, Massachusetts, September 12.

Claim.—"I claim the perforated hook or needle and the conductor, in combination with one another, and made to operate together, substantially as set forth. I also claim the conductor, in combination with the hooked rib needle, the whole being constructed and made to operate together, substantially as set forth."

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17. For an *Improvement in Shingle Machines;* Miles R. Payne, Waldo, Delaware county, Ohio, September 12.

Claim.—"What I claim as my invention, is the combination of the wedge-shaped vibrating setting bar and spring setting arm, arranged and operating as set forth."

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18. For an *Improvement in the Sliding Breech Pin and Self-Capping Gun;* Christian Sharps, Cincinnati, Hamilton county, Ohio, September 12.

The patentee says,—"The nature of my invention consists in the following particulars, viz., the construction to admit of a cartridge being inserted in the breech of the barrel, on a line with the bore; the breech slide cutting off the

cartridge; its having a stationary tube with many caps; and the caps being put upon the nipple by the moving of the sliding breech."

Claim.—"What I claim as my invention, is the combination of the sliding breech with the barrel, the breech supporter, and the stock, in such a manner as that, when the sliding breech is forced down, the breech bore will be so exposed as to enable it to receive a cartridge on a line with the bore; and when the sliding breech is forced up, it will shear off the rear end of the cartridge, so as to expose the powder to the fire communication, and will firmly and securely close the breech bore, substantially as set forth. I also claim the combination of the cap-nipple with the sliding breech, substantially in the manner set forth.

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19. For an *Improvement in Washing Machines;* Stephen Baldwin, Williamson, Wayne county, New York, September 12.

The patentee says,—"The nature of my invention consists in constructting a washing machine having an oblong reservoir, in which, at a few inches below the bottom, is placed horizontally or transversely a fluted bed-piece, on which the clothes are laid, and over which a correspondingly fluted roller is moved by means of a sweep attached to its axle; and the application of water to the clothes whilst in the machine, in continuous small streams before and behind the roller, from a tank above, attached to the sweep or dasher and moving coincidently therewith, and with the roller."

Claim.—"What I claim as my invention, is the combination with the dasher of the washing machine, a tank for holding and supplying the wash water, substantially as set forth."

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20. For an *Improvement in Controlling Motive Power;* F. E. Sickles, City of New York, September 12.

The patentee says,—"The nature and character of my invention consists in making a connexion from the applying machinery to the driving machine, which is acted on by an operator in such a manner as that, by the motion of the operator, this regulating connexion will act on the applying machinery, and thereby regulate the amount of propelling force applied."

Claim.—"What I claim as my invention, is the use of the within set forth regulating connexion, to be acted on by an operator, and applied between and in connexion with applying and driving machinery, so as to regulate the amount of moving power, substantially on the principle and in the manner set forth."

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21. For an *Improvement in Door Locks;* William Stephenson, Cincinnati, Hamilton county, Ohio, September 12.

Claim.—"What I claim as my invention, is, 1st, the application of the circular revolving notched plate and the pins thereon, the slide and dog, constructed and operating as set forth.

"2d, I likewise claim the employment of the additional pin, inserted into the bolt, in combination with the pins in the revolving plate, arranged and operating in the manner set forth.

"3d, I also claim the application of the slide, in combination with the additional tumbler, constructed and operating substantially as set forth.

"4th, I likewise claim the combination and arrangement of the additional arm on the tumbler, in connexion with the circular revolving plate, arranged and operating in the manner set forth.

"5th, I claim the arrangement of the division plate, between the inner and outer key of the lock, to prevent the lock being picked when locked on the inside, as set forth."

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22. For an *Improvement in Machinery for Cutting and Arranging Paper;* J. C. Kneeland and G. M. Phelps, Troy, Rensselaer county, New York, September 12.

Claim.—"What we claim as our invention, is, 1st, making the table on which the sheets are piled with guide strips, as set forth, to adjust the two edges of the sheets widthwise, as they are received from the cutting machine, whereby the necessity of adjusting the sheets against a straight-edge by hand is avoided, and this we claim irrespective of the manner in which the sheets are transferred from the cutting machine to the table.

"2d, We claim the method, substantially as set forth, of adjusting that end of the sheets which first falls on the table, by means of the movable straight-edge called the check motion, substantially as set forth; and we also claim the method of adjusting the sheets, by the action of the other straight-edge against the other edge of the sheets, substantially as set forth; and we also claim the combined action of the two straight-edges, or check motion, acting alternately against the two ends of the sheets, substantially as set forth, whereby any defect arising from the defective action of the first is remedied by the second, as set forth.

"3d, We claim taking the sheets of paper from the cutting machine, and delivering them on to the table, by a motion taken from the rotating cutter, in the manner set forth, or in any other substantially the same, to insure the delivery of the sheets at the proper time."

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23. For an *Improvement in Shingle Machines;* William Smith, Bangor, Penobscot county, Maine, September 12.

Claim.—"What I claim as new, is connecting the lever, which rests on the shingle bolt to be sawed, with the carriage, in combination with the pawl and sliding rack, for throwing the feed pinion out of gear, substantially as set forth. I also claim the weights, arranged and combined with the levers, for causing the ends of the lever alternately to penetrate, and the hooks thereon to catch, in the manner and for the purpose set forth."

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24. For an *Improvement in Horse Powers;* Job Arnold, Freeport, Stephenson county, Illinois, September 12.

Claim.—"What I claim as my invention, is the method of regulating and rendering equable the motion of tread-wheel horse powers for driving machinery, by simultaneously changing the position of the adjustable beam on which the horses moving them pull, and the halter to which their heads

are fastened, as set forth, by which they are compelled, without whip or driver, to perform a uniform amount of duty."

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25. For an *Improvement in Double Bellows Pumps;* Daniel Deshon, Jr., and E. Z. Webster, New London, Connecticut, September 12.

The patentees say,—"The nature of our invention consists in arranging and constructing the parts so as to obviate difficulties and form a cheap permanent pump, in a compact form, and easily worked by the bather with a slight motion of his feet."

Claim.—"What we claim as our invention, is the combination and arrangement of the parts of the pump in the manner set forth, viz. by forming the base with a sufficient bevel each way for the motion of the platform, and forming thereby a space sufficient for the introduction of the water ways, as set forth, without occupying any more room than is necessary for the working of the pump."

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26. For an *Improvement in the Theory of Ship Building;* James K. Howe, City of New York, September 19.

The patentee says,—"My improvement consists in a method of giving to the outline or external shape of the hull of the vessel or boat, of whatever size may be required, the form of arcs of circles, in combination approaching or resembling elliptical lines, and of ellipses, under certain rules and relative proportions; and these circles or ellipses are to be applied, as well to the lateral shape and position of the sides or ribs of the vessel, as to the shape of the under side or bottom of the vessel, measuring on a line following the keel from stem to stern."

Claim.—"What I claim as new, is the method of determining the configuration of vessels of all sizes, by describing the outline of the bottom, or what I call the 'dead rise,' by two arcs of unequal circles or ellipses, which meet on the upper edge of the keel, (which is their common tangent,) at what I call the 'central point,' in combination with curves or arcs of circles or ellipses described as aforesaid, and forming the outline of the ribs, all the ribs in the same vessel being segments of the same curve, and set upon or along the curve of the 'dead rise' fore and aft, the transverse planes in which the ribs are placed coinciding with planes radiating from the centres of the circles or ellipses of which the curves of the 'dead rise' are segments."

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27. For an *Improvement in Refrigerators;* Thomas B. Smith, Philadelphia, Pennsylvania, September 19.

Claim.—"What I claim as my invention, is the application to refrigerators of the doorway and non-conducting partitions, to obtain entrance without affecting the temperature inside, as set forth, in combination with said refrigerator the employment of pipes or valves to admit cool air into the adjacent rooms."

28. For an *Improvement in Sizing and Drying Cotton Batting;* Henry A. Stearns, Cincinnati, Hamilton county, Ohio, September 19.

The patentee says,—"The nature of my invention consists in providing two parallel metallic rollers for sizing, one of which is hung on a frame which is movable, so as to allow a small stick, with the cotton battin attached, to be passed between the rollers to be sized on both sides; also, a long narrow drying chamber, heated by steam pipes, through the whole length of which the cotton batting, when sized, is made to pass slowly, by resting the two ends of the said sticks upon or across two endless belts, which pass through its whole length, all of which is done by one operator."

Claim.—"What I claim as my invention, is, 1st, the attaching one of the rollers to a movable frame, bringing it in contact with the other roller either by its own weight or a spring, thus allowing the stick to be passed between the two rollers, and causing the movable roller to close again immediately upon the batting which follows the stick.

"2d, The attaching of each piece of cotton batting to a stick, and the passing the stick with the cotton attached between the rollers.

"3d, The placing of the long narrow drying chamber, with its open mouth within reach of the operator, having two endless belts passing through its length, upon which the operator can place the two ends of the stick containing the cotton wadding, and subject it to immediate heat, and cause it to be conveyed slowly through the entire length of the drying chamber without further trouble.

"4th, I claim the combination of the three foregoing items, viz. the movable roller, the passing of the stick between the two rollers, and the passing of the sized wadding immediately through the drying chamber by means of endless belts, as a new and improved mode of manufacturing cotton wadding."

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29. For an *Improvement in Steam Hammers;* Lewis Kirk, Reading, Berks county, Pennsylvania, September 19.

Claim.—"What I claim as my invention, is combining a horizontal steam engine with the helve of a hammer, by means of an arm and jointed link, or its equivalent, substantially as set forth."

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30. For an *Improvement in the Ice Cream Freezer;* Anthony H. Austin, Baltimore, Maryland, September 19.

Claim.—"What I claim as my invention, is the employment of the combined concentric circular planes and dashers, in combination with the freezing apparatus, made as set forth, said planes operating in the manner set forth."

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31. For an *Improvement in Apparatus for Rotting Hemp;* Charles H. Van Dorn, St. Louis, Missouri, September 19.

The patentee says,—The nature of my invention consists in heating the water in the hemp and flax vats, by passing tubes of hot air through them, and then causing the heated air to enter the drying room where the hemp

or flax is dried, thus using all the heat from the furnace, and economically rotting and drying the hemp or flax to prepare it for breaking."

Claim.—"What I claim as my invention, is the employment of heated air in the manner set forth, for heating the vats, for rotting the hemp or flax, and then passing said heated air into the drying room, for drying the hemp or flax that has been rotted preparatory to breaking, by which a great economy of heat is effected. I also claim placing regulators in the vats, for keeping the water at the proper temperature, combined and connected with the valves or dampers in the chimney and heated pipes, as set forth, so that, by increasing or diminishing the heat, the dampers shall be opened or closed as set forth."

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32. For an *Improvement in Hulling Wheat preparatory to Grinding;* Saml. Bentz, Boonsboro', Maryland, September 19.

Claim.—"What I claim as my invention and discovery, is the effectually and practically removing the outer coating of wheat and rye by the process set forth, before it is submitted to the grinding operation, whether effected in the precise manner and by the exact means set forth, or in any other way substantially the same."

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33. For an *Improvement in the Window Fastener;* James W. Evarts, New Haven, Connecticut, September 19.

Claim.—"What I claim as my invention, is the combination of the parts, by making the fastener in such a manner as that the button, bolt, or catch, and the spring which moves and sustains it, shall be enclosed in a small, snug, and neat case; with the wards in the case so arranged and formed that, by turning the button, bolt, or catch, to fasten the sash, it will (by means of the spaces or grooves in the button, bolt, or catch, working on the wards) also draw the two casements of the sash snugly together, and hold them perfectly steady and firm; and so that the button, bolt, or catch will be so supported and sustained by the several parts of the case and screw, (or rivet,) that it will not be liable to be strained out of its proper position, or injured by any less force than would be required to cut the button, bolt, or catch, square off in the case which sustains it; and so that the button, bolt, or catch will be moved to, and sustained firmly in, its proper position at all times, both when fastened and when unfastened, by a single spiral spring made with one or more turns or coils, so constructed, fitted, and arranged, as to work freely and effectively both ways: that is, to fasten and unfasten; the whole constructed, arranged, combined, and operating, for the purposes substantially as set forth."

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34. For an *Improvement in the Metallic Grummet;* E. H. Penfield, Middletown, Middlesex county, Connecticut, September 19.

The patentee says,—"The nature of my invention consists in making a grummet with an inside and an outside lock; this I do by making it of two ferules having a rim turned upon one edge about half an inch broad; one of said ferules is made with teeth just large enough to slip over the inside ferule, which is left smooth on its edges as a common cylindrical socket.

After cutting a hole in the sail just large enough to receive the grummet, the outside one, or one having teeth, is put though the hole, the inside one, or one with a smooth edge, is then put through, and a conical pin is then drove though, which turns the teeth of the outside one into the cloth, and the edge of the inside one firmly on to the rim of the outside one, thereby firmly fixing it."

Claim.—"What I claim as my invention, is making a grummet of a metallic cylindrical tube or ferule, having a solid disk or rim on one edge, and a similar shaped solid disk with a ferule made with teeth or points, which two together pass through the cloth, and lock in such a manner that the teeth or points may turn over and press upon the cloth, to prevent its being strained and torn, or injured by the strain on the sail, the whole constructed and arranged as set forth."

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35. For an *Improvement in Preparing Shoe Pegs;* Charles Gifford, Braintree, Norfolk county, Massachusetts, September 19.

The patentee says,—"The nature of my improvement consists in saturating common wooden shoemakers' pegs with a certain solution or composition, by which the pegs are hardened, prevented from swelling or shrinking, and consequently repel water better, and cling to the leather better, than any other peg."

Claim.—"What I claim as my invention, is the discovery of the composition and its application to, and use for, shoemakers' pegs, so as to make them hard, strong, and water proof."

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36. For an *Improvement in Posts for Telegraphs, &c.;* Henry G. Hall, Kirkersville, Licking county, Ohio, September 19.

The patentee says,—"The nature of this invention consists in preventing the posts supporting magnetic telegraph wires from rotting at the surface of the ground, by forming on their lower ends shanks or tenons, and inserting the same into sockets, formed in cast iron shoes, made flaring and sharp on their upper or concave ends, to allow them to be driven into shoulders on the posts which are of greater diameter than the shoes, in order to overhang and protect them, and prevent the water getting into the shoes at the joints, said sockets or concavities being made of greater depth than the length of the tenons, in order to leave spaces between their bottoms and the ends of the tenons after the shoes are driven on the same, and thus allow them to be driven farther on when required."

Claim.—"What I claim as my invention, is the manner of combining the cast iron, or artificial stone, shoes with the posts, by casting the shoes with sockets, of a depth greater than the length of the tenons, on the lower ends of the posts, to be inserted into said sockets, and with fillets or bands around the external surfaces to strengthen the concave ends, which are also made flaring and sharp, so as to be forced into the shoulders o the posts, which are to be of greater diameter than the shoes, in order to overhang and protect them, and to prevent the water getting into the shoes at the points."

37. For an *Improvement in the Portable Forge;* Christian V. Queen, Peekskill, West Chester county, New York, September 19.

Claim.—"What I claim as my invention, is the employment of a trough or spout to carry off any water that may fall on the hearth, the same being combined with the forge in the manner set forth."

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38. For an *Improvement in Abdominal Supporters;* John W. Phelps, Boston, Suffolk county, Massachusetts, September 19.

Claim.—"What I claim as my invention, is the combination of a back piece, made in two parts and jointed together, as set forth, with the abdominal pad and lateral springs, the whole being constructed and arranged as set forth."

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39. For an *Improvement in Door Springs;* John Maxson, De Ruyter, Madison county, New York, September 19.

Claim.—"What I claim as my invention, is the method of closing doors, &c., by means of a spring attached thereto, and acting on, and in combination with, a cam attached firmly to the door frame, as set forth, whereby the effective force is increased as the tension of the spring decreases, substantially as set forth. I also claim the method of regulating the tension of the spring, by combining therewith the screw-rod that carries the roller that acts on the cam, the sliding tube, and the regulating nut, as set forth."

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40. For an *Improvement in Water Wheels;* Henry Van Dewater, Philadelphia, Pennsylvania, September 19.

Claim.—"What I claim as my invention, is the entire shape, construction, and operation of the gate, with the method of moving it and regulating the supply of water by the lever."

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41. For an *Improvement in the Method of Attaching Tillers;* John G. Hull, City of New York, September 19.

The patentee says,—"The nature of my invention consists in providing an attachment of a tiller to a rudder without morticing or weakening the rudder head, and to give a long purchase on the tiller, whereby both are strengthened, and to support the tiller with connecting bars from a truss band secured on the rudder, from which the bars pass forward on each side, taking their action distant from the rudder, and in order to prevent the impulse of a sea from breaking the castings, they take their pressure against fixed springs on the tiller."

Claim.—"What I claim as my invention, is the mode of attaching the tiller to a solid rudder head, by hooping the same with a truss band, to which my tiller is applied and supported by two connecting bars, which take their effect on the tiller by their connexion with the sockets and springs, ways and straps on each side, as set forth.

"2d, I claim the double action compress springs on the tiller, to prevent any sudden impulse of the sea from breaking the castings or any part of

my apparatus or tiller, or any part of the steering gear to which it is applied."

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42. For an *Improvement in Locomotives;* Gustavus A. Nicolls, Reading, Berks county, Pennsylvania, September 19.

Claim.—"What I claim as my invention, is, 1st, the employment of a boiler, constructed in the manner and for the purposes set forth, when combined with an engine on a separate carriage, as set forth.

"2d, The employment of a cylinder to constitute the body of the engine carriage, connected and combined with the steam cylinder, as set forth, into which the steam cylinders exhaust, to act as a hot well and partial condenser, and to give the required weight to the engine, that the traction of the driving wheels and the weight may be regulated and adapted to the load to be drawn, and to the condition of the road.

"3d, I claim the air condenser, in combination with the steam cylinders and water cylinder, for the purpose of condensing the exhaust steam, substantially as set forth, the condenser being cooled by the action of the atmosphere.

"And finally, I claim placing the closed ash pan of the boiler furnace on the boiler carriage, in combination with the fan blower placed on the engine carriage, the two being connected by means of an elastic or other yielding pipe, substantially as set forth."

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43. For an *Improvement in Washing Machines;* John Young, West Galway, Fulton county, New York, September 19.

The patentee says,—"The nature of my invention consists in constructing a flexible fluted washboard, by making it of segments and suspending the segments upon a cord, strap, or other flexible support, and in combining with the washboard a pair of rotary conical rubbers or rollers and squeezers, mounted upon a car or alternating box, which moves the clothes on the surface of the fluted board."

Claim.—"What I claim as my invention, is the combination of the conical rollers with the hinged platform, for the purpose of rubbing the clothes and squeezing the water out of them at the same time, as set forth."

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44. For an *Improvement in Fountain Pen Holders and Nibs;* A. S. Lyman and M. W. Baldwin, Philadelphia, Pennsylvania, September 19.

Claim.—"What we claim as our invention, is, 1st, the method of supplying ink to pens from a reservoir in the handle, by means of a bag or chamber, the whole or part of which is made of gum elastic or other yielding substance, substantially as set forth, whereby the writer can, by the pressure of the finger or thumb, supply the nib with ink while writing, and thus avoid the necessity of dipping the pen. We claim the method, substantially as set forth, of preventing the escape of ink from the fountain, by combining the spring plug, attached to the cap, as set forth. And finally, we claim making pens by coating or plating quill nibs with metal, substantially as set forth."

45. For an *Improvement in Harness Buckles;* Reuben A. Holmes, City of New York, September 19.

Claim.—"What I claim as my invention, is the combination of the metallic case with the cross bars and buckle tongue, substantially as set forth."

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46. For an *Improved Method of Affixing Mortise Locks to Doors;* Rodolphus Kinsley, Springfield, Massachusetts, September 19.

The patentee says,—"The nature of my invention consists in so constructing a lock, as that it can be put into a door without mortising with a chisel, simply by boring, and in fastening said lock and escutcheons in place without the use of screws."

Claim.—"What I claim as my invention, is the face plate, so formed as to be fitted by boring alone, without the use of a chisel. I claim, also, constructing the escutcheon in the manner set forth, with a projecting flanch on the inside, on which are spurs, by which the escutcheon is fastened to the door without screws, substantially in the manner set forth."

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47. For an *Improvement in Stave Machines;* Hervey Law, Wilmington, Hanover county, North Carolina, September 19.

Claim.—"What I claim as my invention, in combination with the cutter, rest, or follower, or any well known mechanical equivalent thereof, is the separate supporting levers, acted on by weights, one lever acting on each edge of the stave, to produce separate and independent pressures near the two edges, holding it firmly against a single fixed piece or rest immediately opposite to the cutters, but permitting all other parts of the stave, however crooked, twisted, or variable in thickness, to pass free from constraint, and at full liberty to take whatever movements, lateral and vertical, its crooks and windings may require, whereby the dressing is allowed to follow the bendings and windings of the stave, without cutting across the grain of the timber; and, in combination with the parts above claimed, I also claim the segmental holdfasts, acting to draw the stave from between the cutter wheel and roller, and thereby prevent the irregular thinning away of its extremities."

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48. For an *Improvement in Screw Threading Machines;* Henry L. Pierson, assignee of John Crum, City of New York, September 19.

Claim.—"What I claim as my invention, is the carrying wheel on the reciprocating carriage, operated substantially as set forth, in combination with the dies in the jaws of the mandril, as set forth, whereby the stem of the screw is moved in and out, for the chasing or cutting of the thread of the screw, by a series of operations, as set forth. I also claim the method of holding the blanks in the rim of the carrying wheel, by combining with the rim of the wheel the pressure roller, substantially as set forth. And finally, I claim the method of increasing the depth of the cut of the chasers or dies in the jaws of the mandril, for each cut in the series, by the threading cam and the wedge-formed slide, operated substantially as set forth, in combination with the carrying and holding wheel, as set forth."

49. For an *Improvement in Refrigerators;* Nathaniel Waterman, Boston, Massachusetts, September 19.

The patentee says,—"The nature of my improvement consists, 1st, In ventilating the refrigerator through its top or lid. 2d, In making the top a close hollow box or chamber, to be filled with atmospheric air only, instead of having two lids, viz. an inner and an outer one, as refrigerators are usually constructed. 3d, In employing uncirculating or confined air, as the non-conducting agent or medium between the inner and outer cases of the refrigerator, instead of charcoal or other stuffing, such as has been commonly used. 4th, In a peculiar valve or contrivance for letting off the waste water and fluid matters which may be discharged from the ice or any meats or articles placed within the refrigerator."

Claim.—"What I claim as my invention, is, 1st, the arrangement of the ventilating apparatus or register, in the lid or at the top of the chamber, as set forth.

"2d, The peculiar capillary valve cesspool, as constructed with the circular shallow groove in the seat plate, and its counterpart on the flap, and made to operate in the manner and for the purposes set forth."

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50. For an *Improvement in Loom Pickers;* Josiah M. Colburn, Derby, New Haven county, Connecticut, September 26.

The patentee says,—"The nature of my invention consists in applying or inserting a portion of caoutchouc, or india rubber, to that point of the shuttle picker which meets the point of the shuttle when in use in the loom."

Claim.—"What I claim as my invention, is the addition, application, or insertion of india rubber to that part of weavers' shuttle pickers when the point of the shuttle strikes the picker."

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51. For an *Improvement in Saddle Trees for Carts;* Thomas Glasco, Wilmington, New Castle county, Delaware, September 26.

Claim.—"What I claim as my invention, is the friction rollers, constructed so as to slide on their axes, in the manner and for the purposes set forth."

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52. For an *Improvement in Jaw Temples for Looms;* Benjamin Peck, Rehoboth, Bristol county, Massachusetts, September 26.

Claim.—"What I claim as my invention, is the particular combination and arrangement of parts, whereby the jaws and wedge are operated by the lay being made to beat up against one arm of a lever only, and the jaws, while being operated by the wedge, are held in position by a notch of the other arm of the said lever."

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53. For an *Improvement in the Upper Floors of Ice Houses;* Peter Kephart, Baltimore, Maryland, September 26.

Claim.—"What I claim as my invention, is the so constructing of said apparatus, as that the ice shall be so protected by the sinking sectional

non-conducting floor as to arrest, in a great measure, the large amount of waste produced by the warmth of spring and summer, the said arrangement also preserving a dry pleasant atmosphere in the house, and at the same time affording easy access when ice may be required, the respective parts being arranged and operating substantially as set forth."

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54. For an *Improvement in Dressing Staves;* Hosea Benson, Jackson, Susquehanna county, Pennsylvania, September 26.

The patentee says,—"The nature of my invention consists in a novel arrangement and combination of drivers and arms, connected together by joint pins, to which is imparted a horizontal revolving small cam wheel, by which the stave is forced between vertical shaves or cutters of the usual concave and convex forms, and by which the stave is dressed on its sides to the required form and thickness; and also the combination of certain other parts, by which the stave, after being dressed on its flat sides, is listed on its edges to its required taper, from the centre to the ends, to form the bilge, and at the same time bevelled on the edges to correspond with the curvature; the back or return movement of the drivers being effected by the gravity of weights attached to cords fastened to jointed arms attached to the drivers, and running over channelled pulleys."

Claim.—"What I claim as my invention, is, 1st, the combination of the driver, adjustive roller, and loose cutters or shaves, for shaving crooked or winding staves, as set forth.

"2d, I claim the employment of the vibrating patterns, in combination with the inclined blocks upon which they are placed, and the double edged cutters for listing bilge staves, as set forth."

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55. For an *Improvement in Cultivators;* George Gross, Jr., Germantown, Montgomery county, Ohio, September 26.

Claim.—"What I claim as my invention, is the so combining and arranging of the wings of my cultivator with the supporting frame, that their posterior extremities can be brought nearer to, or separated farther from, each other, and the rows of corn, &c., to be cultivated thereby without varying the angle of inclination of the wings with each other, substantially as set forth."

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56. For an *Improvement in Machinery for Breaking and Cleaning Hemp;* Lewis W. Colver, Glasgow, Howard county, Missouri, September 26.

Claim.—"What I claim as my invention, is, 1st, the peculiar construction of the curved or hooked knives on the ends of the alternate vibrating breaker beams, for the purpose of taking the hemp in between the edges of said cleaner knives with facility, said knives acting successively on the hemp in the manner set forth.

"2d, I also claim balancing the three beams on an axle, in combination, and causing them to operate successively by a three-throw crank, or other equivalent means, whereby much power is saved, injury to the hemp is avoided, and the resistance of the machine is at all points nearly the same, the whole being constructed and operating substantially as set forth."

57. For an *Improvement in Washing Machines;* Charles Leonard, Indianapolis, Marion county, Indiana, September 26.

The patentee says,—"The nature of my invention consists in mounting, in a rectangular or other formed wash box or tub, three revolving cylindrical brushes and a revolving rest, between which brushes the clothes are caused to pass, and by the action of which, combined with the cleansing effect of the soap and water, the dirtiest clothes are quickly cleaned."

Claim.—"What I claim as my invention, is the combination and arrangement of the revolving brushes with the revolving and vibrating brush, in the manner and for the purposes set forth."

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58. For an *Improvement in Machinery for Turning the Heads of Wood Screws;* J. L. Pierson, assignee of John Crum, City of New York, September 26.

Claim.—"What I claim as my invention, is paring off or turning the heads of the blanks within the rim of the carrying or holding wheel, which has a reciprocating motion from and towards the mandril, by combining therewith a cutter or cutters that move towards the blank by a motion at right angles to the axis of the blank, substantially as set forth."

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59. For an *Improvement in Bridles;* Henry Seitz, Marietta, Lancaster county, Pennsylvania, September 26.

Claim.—"What I claim as my invention, is, 1st, the employment of the stops attached to the reins, in combination with the cylinders containing the pulleys and axles, arranged and operated in the manner and for the purpose set forth.

"2d, I also claim the employment of the perforated flanched cylinders and wheels, in combination with the bit, in the manner and for the purpose set forth."

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60. For an *Improvement in the Method of Raising Water;* Elijah H. Holt, Fowler's Mills, Geauga county, Ohio, September 26.

The patentee says,—"The nature of my invention consists in the combination of a peculiar bucket, so constructed as to fill with water when let down into the well, and emptying itself when raised to the desired height."

Claim.—"What I claim as my invention, is the combination of the shaft, arm, pins, lever, weight, and rod, arranged substantially as set forth, with a valve-bottomed bucket, for the purpose of discharging the same."

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61. For an *Improvement in Lanterns;* Henry Evans, Jr., Newark, Essex county, New Jersey, September 26.

The patentee says,—"The nature of my invention consists in the formation and mode of combination of the several parts which constitute the lantern, in such a manner as to save much of the ordinary expense of labor in the construction thereof, and constitute a lantern of extraordinary excellence for common use."

Claim.—"What I claim as my invention, is the within described peculiar mode of constructing the sides or peripheries of lanterns, which consists in soldering to each other, vertically, several tin plates, the edges of which are bent inwards, so as to form grooves to receive the edges of plates of wires or glass, as set forth."

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62. For an *Improvement in Brakes for Cars;* John Ellenwood, Hillsborough, Hillsborough county, New Hampshire, September 26.

Claim.—"What I claim as my invention, is the manner in which I adapt the wedges to both of the wheels against which they act, or, in other words, I claim the combination of the wedge carriage, (composed of the levers and sustaining wheels, other parts substantially as set forth,) with the car and its wheels, and the friction wedges or their equivalents, the whole being constructed and made to operate substantially as set forth."

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63. For an *Improvement in Lime Kilns;* Eleazer Orcutt, Bennington, Bennington county, Vermont, September 26.

Claim.—"What I claim as my invention, is constructing the top of the kiln, with the cupola above the arch, as set forth, said arch and cupola being made with the draught holes, for the purpose of regulating the heat of the kiln, the regulating of the heat being produced by opening and closing the said holes, and the confining and saving of the heat being effected by constructing the arch over the kiln, and the cupola over the arch, as described."

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64. For an *Improvement in Boring Machines;* Joseph Jones, Camden, Camden county, New Jersey, September 26.

Claim.—"What I claim as my invention, is, 1st, the combination of the graduated sliding legs with the carriage, for the purpose of supporting the several rests in various positions, as set forth.

"2d, The combination of the adjustive platform and carriage with the compound adjustive rest, for the purpose of holding any substance to be bored, and advancing the same upon the augur, in such position that holes will be made in it in any required direction.

"3d, The combination of the compound adjustive clamp with the adjustive rest, as set forth, for the purpose of clamping and holding firmly any substance which it may be required to bore, whether the same be of regular or irregular form."

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65. For an *Improvement in Saw Sets;* Abel Stillman, Poland, Herkimer county, New York, September 26.

Claim.—"What I claim as my invention, is the revolving jaw, having at the ends of its arms depressions of different lengths and depths, and lengths for different teeth, in combination with the angle bar and adjusting screw, substantially as set forth."

66. For an *Improvement in Hemp Brakes;* Harvey Guild, Cincinnati, Hamilton county, Ohio, September 26.

Claim.—"What I claim as my invention, is the application to the purpose or operation of breaking hemp or like fibres in a power brake, of revolving beaters, after the manner or principle set forth, in combination with the vibrating prongs applied to my power brake."

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67. For an *Improvement in Cutting the Screws on Rails of Bedsteads;* Spencer Lewis, Tiffin, Seneca county, Ohio, September 26.

Claim.—"What I claim as my invention, is the combination and arrangement set forth, of the half or sectional cutter, secured on the end of the inner surface of the tubular holder, with the entire cutter, also secured to the inner surface of the holder, for the purpose of cutting a sectional thread adjacent to the shoulder of the tenon on the end of the rail, corresponding to the sectional thread cut on the outer end of the female screw in the post, so that the rail, having a square shoulder, and the thread of the screw cut on the entire length of the tenon, may be screwed up tight against the face of the post, forming a close and perfect joint, which cannot be effected by any other machine in use or known."

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68. For an *Improvement in Platform Scales;* Stephen F. Stevens, assignee of John Underwood, Montpelier, Washington county, Vermont, September 26.

Claim.—"What I claim as my invention, is the manner in which I arrange and combine the levers for supporting the platform: that is to say, I claim connecting the short arms of these levers, by extended connecting bars, with similar short arms at the other end of the platform, said short arms sustaining the platform in the manner set forth, whereby my scale presents fewer points of bearing and connecting parts than others in use. I also claim as my invention, the use of the screw for a scale beam, and the mode of registering the divisions of weight on the graduated plate fixed to the beam, and on the circumference of the cylindrical poise."

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69. For an *Improvement in Self-Loading and Self-Capping Repeating Fire Arms;* Milo M. Cass, Utica, Oneida county, New York, September 26.

Claim.—"What I claim as my invention, is, 1st, the employment of an endless chain of cartridge boxes, open at both ends, for conveying the cartridges in succession to the chamber of the fire arm, in combination with the table for preventing the descent of the cartridges, the guide of the ramrod through the same in driving the cartridge from the conveyor into the chamber.

"2d, I also claim the employment of the jointed lever, in combination with the endless chain of cartridge boxes, for revolving the same, propelling the ramrod or piston, and closing the segment stopper into the hollow breech pin, as set forth.

"3d, I claim the use of a revolving disk of nipples, containing the percussion caps, in combination with the lock for producing successive dis-

charges, as set forth, irrespective of the endless chain of cartridge boxes and jointed levers, and other parts of the fire arm."

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70. For an *Improvement in Railroad Cars;* John F. Rodgers, Troy, Rensselaer county, New York, September 26.

Claim.—"What I claim as my invention, is supporting the truck on journals made each side of the wheels, on the hubs or short axles, when this is combined with the long axle passing through the hubs or short axles, substantially as set forth."

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71. For an *Improvement in Grain Dryers;* Hiram H. Scoville, Chicago, Cook county, Illinois, September 26.

Claim.—"What I claim as new, is the particular manner in which I have combined and arranged the respective parts thereof: that is to say, I claim, in combination, the spaces and the scrapers passing through the former, by the action of endless chains or bands, the said spaces being connected with the flues, and the whole operating substantially in the manner and for the purposes set forth."

List of American Patents which issued in the month of October, 1848, *with Exemplifications, by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in Machinery for Cleaning Tobacco Leaves;* James E. Allen, Oxford, Granville county, North Carolina, October 3.

Claim.—"What I claim as my invention, is the mode of spreading and brushing tobacco by rotary brushes, in the manner set forth."

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2. For an *Improvement in Machinery for Planishing and Hammering Metal;* Cornelius D. Goodrich, Ann Arbor, Washtenaw county, Michigan, October 3.

The patentee says,—"The nature of my invention consists in a machine furnished with a balance wheel, to which is attached a groove circle near the centre, into which are inserted any number of anti-friction rollers desirable; a lever with the segment of a circle or cam made on, or attached to, the end, which lever is attached or connected to a hammer; this lever is fastened or plays in a movable or sliding box inserted into the fulcrum of the lever; a spring connected with the hammer; a hammer and anvil."

Claim.—"What I claim as my invention, is the combination of the balance wheel, groove circle, anti-friction rollers, segment or cam, lever, sliding or graduating box, and spring, combined and arranged so as to produce a blow by the hammer.

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3. For an *Improvement in Printing Presses;* Joseph M. Marsh, City of New York, October 3.

Claim.—"What I claim as my invention, is the method of obtaining a

reciprocating motion from a continuous rotary motion, by combining with a cogged rack two cogged wheels, composed each of segments of different diameters, the small segment of one wheel engaging the cogs of the large segment of the other, and *vice versa*, as set forth. I claim, in combination with the combined segmental cog wheels, made and running together as set forth, making the cogs of the rack of gradually less depth towards the ends, and towards the middle of its length, and with a long cog at each end, substantially as set forth. I also claim the method of sustaining the bed of the press as it reciprocates against the pressure of the cylinder, by combining with the bed one or more ways and rolling segmental bearers, substantially as set forth. I also claim the method, substantially as set forth, of elevating and depressing the inking rollers, as the bed of the press runs in and out, by combining with the rollers the sliding boxes and the trip levers, operated by the reciprocating carriage, as set forth. And finally, I claim operating the finger bar by means of spring-jointed arms at the end thereof, substantially as set forth, to admit of turning back the cylinder without injury to the arms, finger bar, or fingers, as set forth."

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4. For an *Improvement in Manufacturing Sheet Lead;* John Robertson, Brooklyn, Kings county, New York, October 3.

Claim.—"What I claim as my invention, is the mode of manufacturing such hollow cylindrical forms of lead, and other soft metals and compounds, into sheets, by first placing them round a roller whose axis may be in a horizontal plane, or in one of any inclination, and then rolling it by any known mechanical means, until it shall be rolled to a proper thickness, substantially as set forth, whereby handling the sheet during the process is avoided, and a continuous rotary motion in one direction may be given to the rolls. I claim the construction of the carrying roller, constructed substantially as set forth, and the manufacture therewith of hollow cylindrical formed pieces of lead, or other soft metal or compound, into sheets by rolling, combined with the movable bearings and pressing roller or rollers, substantially as set forth. I claim the manufacture of lead, or other soft metal or compound, into sheets, by supporting a hollow form thereof, and rolling it by one or more pressing rollers, forced against the outside of the form as it becomes thinner, and drawing out the extended form when required, in the mode set forth."

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5. For an *Improvement in Ice Cream Freezers;* E. C. Seaman, Philadelphia, Pennsylvania, October 3.

Claim.—"What I claim as my invention, is the side scrapers, the bottom scraper, and, in combination therewith, the dashers, the whole being constructed and operating substantially in the manner set forth."

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6. For an *Improvement in Harness Saddles;* A. D. Brown, City of New York, October 3.

Claim.—"What I claim as my invention, is, 1st, the peculiar form of the sheet metal housing plate, caused by the addition of the lower flanches, (or ledges,) constructed substantially in the manner set forth.

"2d, I also claim the securing the pieces of leather forming the under side of the pads, with the housing plate forming the upper side of the same, by means of the fastening plates, with notched (or plain) edges, arranged and combined with the flanches, substantially in the manner set forth.

"3d, I also claim the combination of the housing plate and pads, combined in the manner set forth, with the stiffening arch piece, the straps, and the housing leather, substantially in the manner set forth."

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7. For an *Improvement in Bell Telegraphs;* E. J. Mallett, City of New York, October 3.

Claim.—"What I claim as my invention, is the arrangement and combination of levers, operated by wires, with the hammers and sliding plates, by means of angular or curved faces, substantially as set forth, whereby I am enabled to substitute gravity for the tension of springs, in apparatus for ringing bells and indicating what is wanted or required to be done, as set forth."

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8. For an *Improvement in Grinding Mills;* Edwin Butterfield, assignee of G. W. Clark, Lowell, Middlesex county, Massachusetts, October 3.

Claim.—"What I claim as my invention, is the combination of the two concentric grinding surfaces, within and without the partition, the said partition, passage, and inlet and exit passages, made upon or in the plate, and made to operate in connexion with the plate, all substantially as specified; and whether the grain is received at or near the centre of the plate and discharged at its circumference, or *vice versa*, as set forth."

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9. For an *Improvement in Scales for Weighing;* E. Sampson and E. S. Collier, Weathersfield, Windsor county, Vermont, October 3.

Claim.—"What we claim as our invention, is the combination of the wings with the weighted levers, arranged and operating in the manner and for the purposes set forth."

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10. For an *Improvement in Grist Mills;* Lewis Norton, Madison, New Haven county, Connecticut, October 3.

The patentee says,—"The nature of my invention consists in running grist mill stones without the intervention of gearing from the main shaft."

Claim.—"What I claim as my invention, is the mode of coupling shafts in grist mills, which admits the stones to be set close or apart without the use of gear wheel, constructed and operating substantially as set forth."

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11. For an *Improvement in Table Cutlery;* Marvin Smith, Meriden, New Haven county, Connecticut, October 3.

The patentee says,—"My improvement consists in placing the bolster, that serves as a fulcrum across which the handle is made to balance the blade of the knife or fork, from one half of an inch to two inches from the end of the handle connected with the shoulder, and in place of so much

of the blade, I make a shaft or shank, with the bolster or fulcrum between the shank and the blade."

Claim.—"What I claim as my invention, is making table knives and forks with the bolster between the blade of the knife, (or prongs of the fork,) and the shaft, as set forth; also placing the bolster or fulcrum, across which the weight of the handle causes the blade of the knife (or prongs of the fork) to be elevated above the table, nearer to the point of the knife or fork, and farther from the handle, thereby saving the loading of the handle and other consequent injury."

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12. For an *Improvement in Machines for Hoisting;* J. W. Wilson, Syracuse, Onondaga county, New York, October 3.

The patentee says,—"The nature of my improvement consists in the method of changing the power of a fall, for hoisting heavy bodies on warehouses and other similar places, from a single wheel and axle to a double gear, by which any amount of power can be obtained in a much less space than has heretofore been done, while the facility of operation is greatly increased, and the shifting readily done on any story where the person hoisting stands."

Claim.—"What I claim as my invention, is the combination of the clutch and gear, substantially as set forth, so that the fly wheel and drum shall never be out of connexion, for the purpose set forth."

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13. For an *Improvement in Grinding Mills;* Zachariah Griffin, Montgomery, Montgomery county, Alabama, October 3.

Claim,—"What I claim as my invention, is the combination of the spring, screw, bolt, and set screws, with the bed stone, substantially as herein set forth, for the purpose of adjusting the same in a firm but not rigid manner whereby its breaking from the pressure of the set screws necessary to its adjustment is prevented.

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14. For an *Improvement in Saddle Frames;* Levi Hall, Adrian, Lenawee county, Michigan, October 3.

The patentee says,—"The nature of my invention consists in constructing saddles in such a manner that I am enabled to dispense with the use of saddle trees of ordinary construction, and also in forming the seat and skirts of the saddle of only two pieces of leather united by a seam running lengthwise through the centre of the seat."

Claim,—"What I claim as my invention, is first, the forming a saddle by the combination of the pads, the metallic arch piece, the cantle and covering, substantially in the manner set forth, by which I am enabled to dispense with the ordinary saddle tree and other parts. 2nd. I also claim the staying and giving the proper stiffness to the pads by means of the side boards, placed within the same, substantially at set forth. 3rd. I also claim the construction of the cantle separate from the frame, and combining it with the covering of the seat, and with the pads, substantially as set forth."

15. For an *Improvement in Grinding Mills;* William B. North, Jersey City, Hudson county, New Jersey, October 3.

The patentee says,—"The grinding part of my mill consists of a sphere and of a hemisphere of iron, steel, or other suitable metal, or material.—The spherical part is fixed to, and made to revolve with a shaft placed horizontally, and the hemispherical portion on a shaft that revolves vertically; this hemispherical portion is concave, and embraces the upper portion of the revolving sphere."

Claim.—"What I claim as my invention, is the combining of a spherical body revolving on a horizontal axis, with a hemispherical cup embracing the upper portion of said sphere, and made to revolve on a vertical axis under an arrangement of parts, and for the purposes set forth."

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16. For an *Improvement in Steering Vessels;* Edward Rouse, Augusta, Kennebeck county, Maine, October 3.

Claim.—"What I claim as my invention, is the combination of a compensating barrel, with two sets of toggle joint levers, arranged substantially as set forth, and the whole being made to operate with the tiller, for the purpose set forth, not intending by this claim to limit myself to the precise form of the respective parts, but to vary them as I may find expedient."

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17. For an *Improvement in Horse Rakes;* R. B. and A. C. Jennings, Livermore, Oxford county, Maine, October 3.

Claim.—"What we claim as our invention, is the combination of the reacting spring guard, with the tooth bars, substantially in the manner and for the purposes set forth."

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18. For an *Improvement in Corn Planters;* Jacob Yoder, John Guilleford, and Elias Gruver, Juniata county, Pennsylvania, October 3.

Claim.—"What we claim as our invention, is 1st, the application and use of a skeleton or sifting plough, operating for the purposes set forth.—2nd. The application and use of a spring guard or coulter for protecting the point of the plough from injury, from stones and other obstructions in the manner set forth."

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19. For an *Improvement in Spark Arresters;* Augustus Hamann, Washington city, District of Columbia, October 10.

The patentee says,—"The nature of my invention consists in covering the top of the boiler with a metallic chamber, the bottom of which fits the top of the boiler and extends down the sides thereof, which is so connected with the flue stack as to turn all the products of combustion into it, and cause them to circulate through it, and then deposit the sparks before the smoke escapes through the stack."

Claim.—"What I claim as my invention, is the spark arrester constructed substantially as set forth, covering the top of the boiler and forming a chamber in which the sparks are deposited in horizontal passages or return

flues, which serve for a jacket to the boiler, in the manner and for the purposes set forth."

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20. For an *Improvement in Grinding Mills;* F. M. Hemphill and R. H. Knox, Washington, Fayette county, Ohio, October 10.

The patentees say,—"The nature of our improvement consists in the manner of attaching the spindle to the water wheel shaft, the driver and balance rind formed in one piece, the stationary centre or eye in the runner, and in the manner of bushing the spindle."

Claim.—"What we claim as our invention, is, first, the method of connecting the spindle with the shaft of the water wheel, as set forth, the whole being raised and lowered together, and the spindle having liberty to turn without the wheel, as set forth. Secondly, we claim the stationary centre or eye to the runner, in combination therewith the flaring of the runner below, to prevent the grain clogging in the eye of the stone."

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21. For an *Improvement in Screw Blank Machines;* R. F. Berwick, City of New York, October 10.

Claim.—"I claim the cam for the particular purpose for which it is used in closing the dies, and the manner in which it allows the dies to become loose by the shallow groove upon a part of its surface, and also for the purpose of moving the bolt which contains the dies, thus the cam performs two distinct services. I claim as new the movable caps upon the surface of the wheels, which caps are for regulating the length of wire to be rolled in the dies, as set forth. I also claim the plates which regulate the length of the wire to be cut off. I claim the combination of the different parts of my machine, in the manner set forth."

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22. For an *Improvement in Harness Buckles;* Oscar S. Burges, Columbus, Franklin county, Ohio, October 10.

The patentee says,—"The nature of my invention consists in the application of the combined principles of the slide, wedge, and lever, in connexion with most of ordinary buckle frames; the wedge piece having attached to it a loop of metal through which the end of the strap to be fastened passes, and binds so as to draw the fastening into action, forming thereby a buckle, adapted to all uses required; varying the size and form to suit the purpose for which any buckle is required."

Claim.—"What I claim as my invention, is the slide, wedge, and lever, in connexion with the buckle frame, and its adaptation to most of the known forms of buckle, as set forth, or any mechanical equivalent therefor, substantially the same in principle, in such manner as when in use to bring into operation the principles of the combined slide, wedge, and lever. I also claim the employment of the loop for connecting the wedge, or its equivalent, with that portion of the strap which is to be fastened, so that by drawing upon the strap the fastening will be drawn into action."

23. For an *Improvement in Chimney Caps;* John P. Hayes, Boston, Suffolk county, Massachusetts, October 10.

Claim.—"What I claim as my invention, is, in a ventilator such as I have described, arranging a conical deflecting surface on the *top* of the disk, and also another deflecting surface, having the shape of a frustrum of a cone on the underside of the surface, the arrangement and purpose of the same being substantially as set forth. I also claim the arrangement of a turning cowl constructed as set forth, between the disk and the surface, in the manner and for the purpose set forth."

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24. For an *Improvement in Presses;* David Dick, Meadville, Crawford county, Pennsylvania, October 10.

Claim.—"What I claim as my invention, is the combination of two eccentric sectors having their bearings upon edges as set forth, with a roller placed between them whose axis has free play, all in the manner and for the purpose set forth."

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25. For an *Improvement in Moulders' Flasks;* Livingston, Roggins, and Adams, Pittsburgh, Allegheny county, Pennsylvania, October 10.

The patentee says,—"The nature of our invention, consists in giving the sides of the flask an inward inclination from the bottom of its lower portion, commonly called the drag, to the top of its upper portion, commonly called the cape, for the purpose of enabling the moulder to withdraw the flask from the mould formed therein, and using the same flask for forming any number of moulds."

Claim.—"What we claim as new, is the inclining the sides of the upper and lower portions (commonly called the cope and drag) inwards, from bottom to top, in combination with the sliding plates, or their equivalents connected therewith, substantially in the manner and for the purposes set forth."

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26. For an *Improvement in Ventilating Ships;* Frederick Emerson, Boston, Suffolk county, Massachusetts, October 10.

The patentee says,—"My improvement consists in placing injecting ventilators and ejecting ventilators in different parts of the craft, for removing the foul air therefrom, and supplying its place with pure air from the atmosphere above."

Claim.—"What I claim as my invention, is the employment of two or more certain ventilators, constructed as set forth in combination with water craft, as set forth, for the purpose of removing all noxious and unpleasant gases therefrom, and introducing in their place pure atmospheric air."

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27. For an *Improvement in Manufacturing Spikes;* James H. Swett, Concord, Merrimack county, New Hampshire, October 10.

Claim.—"What I claim as my invention, is, 1st, Holding the piece of iron to form the spike with the point against the dies, fastened in rolls,

whilst the head is being turned and shaped at the same time by the header upon the heading plate, as set forth.

"2d, I claim the crooked header, in combination with the arms to which it is attached, and the gearing for giving it the required movements, by which the spike is hook headed by one motion as set forth.

"3d, I claim the combination and arrangement of the arms, joint bolts for adjusting the crooked headed header.

"4th, I claim constructing the upper die with an additional triangular projection, for shaping one side of the end of the piece of iron that is to form the spike, so as to produce the proper slope, preparatory to its being bent down over the heading plate, by the inclined end of the crooked header as set forth."

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28. For an *Improvement in Uterine Supporters;* James Betts, assignee of Joseph Schofield, Philadelphia, Pennsylvauia, October 10.

The patentee says,—"The nature of my invention and improvement, consists in constructing of porcelain or other suitable material, an artificial support for a prolapsed uterus, which will maintain it in a natural and easy position, without pain or injury, and without irritating or otherwise doing violence to the adjacant parts."

Claim.—"What I claim as my invention, is the combination of elastic retaining straps of india rubber, with the "supporter," which straps being impervious to moisture, may be washed to keep them clean, wholesome, and free from odor, without detaching them from the body."

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29. For an *Improvement in the Shot Plug;* Samuel J. Seeley, City of New York, October 10.

Claim.—"What I claim as my invention, is the plug as set forth for stopping leaks in vessels, caused by the shots of the enemy during an engagement, or by a snag, or from any cause whatever, whether the plug be made precisely in the manner set forth, or in any other mode or manner which shall be substantially the same."

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30. For an *Improvement in Type Moulds;* H. W. Day, Boston, Suffolk county, Massachusetts, October 10.

Claim.—"What I claim as my invention, is the described combination of stationary and movable plates, constituting the body and sprue matrixes as arranged and made to operate together with adjusting contrivances, substantially in manner and for the objects as set forth, and in combination with the matrix of the body of the type. I claim the movable gauge plates, and stop plate, as arranged and made to operate substantially as set forth."

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31. For an *Improvement in Wheels for Spinning;* Jacob Shaw, Jr., Hinckley, Medina county, Ohio, October 10.

Claim.—"What I claim as my invention, is the construction and the combination of the vibrating frame, with the accelerating wheel and bench by means of two hollow rods, constituting an axis for the vibrating frame,

and boxes or bearings for the axle of the accelerating wheel, in such a manner that the motion of the vibrating frame, and the motion of the accelerating wheel will be concentric, and the main and accelerating band retain the same degree of tension, in whatever position the vibrating frame may be placed, or whether in motion or at rest. The combination of the treddle, with the vibrating frame and the bench, and the combination of the parts, composing the axis of the vibrating frame with the frame. And I claim each part and combination before claimed, which has not been before known and used, whether the same is used separately or in combination with other parts claimed, or with parts of spinning wheels which have been before known and used, or with parts which are not now known, but may be hereafter known and used."

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32. For an *Improvement in Corn Shellers;* Charles Sines, Village Green, Delaware county, Pennsylvania, October 10.

Claim.—"What I claim as my invention, is the combination of the vibrating hinged clamp boards, with the revolving shelling wheel for separating the cobs from the corn during the operation of shelling—said clamp boards being constructed with segmental conductors, and inclined aprons arranged and operated in the manner set forth."

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33. For an *Improvement in Blocking Hats;* William Wright, Philadelphia, Pennsylvania, October 10.

The patentee says,—"The nature of my invention consists with what is known among hatters, and hat-block makers, by the name of a hat-screw or set, an elastic band or hoop of a circular or oval form, which hoop or band encircles the hat screw or set, and is fastened to the two ends so as to construct an entire machine, by which the shape of hats may be more easily and perfectly changed, than by the use of the ordinary hat-screw."

Claim.—"What I claim as my invention, is the making and use for the purposes set forth, of the hoop or band of elastic material, whatever its dimensions or precise form, and its combination with the hat-screw or set, as previously in use, or as it may be otherwise modified, in what manner soever the hoop or band may be attached to it, so as to compose the entire machine set forth, and the application of that machine to the purposes set forth."

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34. For an *Improvement in the Apparatus for Breathing Ether;* Lewis Roper, Philadelphia, Pennsylvania, October 10.

Claim.—"What I claim as my invention, is the mouth-piece, or the peculiar formation of the upper part of the instrument or vessel set forth, fitting closely over the mouth and nose, so as to administer the vapor of ether through these two organs simultaneously, and in combination therewith, the arrangement of the air tube and perforated plate."

35. For an *Improvement in Machinery for Doubling and Twisting Yarn;* Thomas Lyle, Collinsville, Blair county, Pennsylvania, October 17.

The patentee says,—"The nature of my invention, consists in a peculiar construction of a flyer for the reception of several bobbins of thread to be doubled, twisted and reeled, arranged one above the other in the same vertical axis, revolved simultaneously, in combination with a revolving reel upon which the thread is wound, after passing from the several bobbins, over guide wires, and through the hollow journal of the spindle, in which the required doubling and twist is imparted to the threads."

Claim.—"What I claim as my invention, is constructing the flyer with several divisions, or spaces, for the reception of as many bobbins as there are threads to be twisted, one arranged over another in the same vertical axis, having grooved division plates, guide wires, and hollow journal, through which the several threads from the bobbins are passed, to be doubled, twisted and reeled, in combination with the reel, upon which the threads or yarns are reeled, as fast as they are doubled and twisted—the whole revolving simultaneously in the manner and for the purpose set forth, whether the several parts be combined and arranged as set forth, or in any other mode which is substantially the same."

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36. For an *Improvement in Making Lead Pipe;* Stephen Parks, Jr., Brooklyn, Kings county, New York, October 17.

Claim.—"What I claim as my invention, is the combination, arrangement and operation with each other of the hollow cylinder, the tube, having a screw formed in a portion of its periphery, the shaft, the core, or mandril, and the die, substantially as set forth."

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37. For an *Improvement in Cylindrical Wrought Nail Machines;* Charles J. Richards, City of New York, October 17.

The patentee says,—"The nature of my invention consists in making a machine to make nails from rods by means of cylinders, four being used; two of which are composed of a disk, with cams attached to springs, and the centre or disk, while there are two others which are for closing the cams; these cams with the springs connected, I call spring hammers. The two cylinders of spring hammers form the nails on their peripheries, and sides or flanches; these being so shaped as to give shape to the nails. The form of the nail to be produced is formed upon the periphery and flanch of the cylinders; that is, the form of the head is indented into and the points raised up on the surface of these cylinders of spring hammers; so that by passing the rods through between the cylinders (the rods being at a welding heat,) the rod will be converted into nails."

Claim.—"What I claim as my invention, is the spring hammers, combined into a cylinder in manner and for the purposes set forth, viz: making nails, spikes, brads, and such like articles.

38. For an *Improvement in Floating Batteries;* John P. Taylor, Little Compton, Newport county, Rhode Island, October 17.

Claim.—"What I claim as my invention, is the employment of a pointed, floating, explosive battery, of the peculiar shape set forth, having an angular recess at the stern, corresponding with the shape of the bow of the propeller received therein, and charged with explosive materials, in combination with a shot and bomb proof steam propeller, having a semi-eleptical covering, for glancing the balls of the enemy; to which it is attached, for driving it into the vessel to be destroyed, and after igniting the slow matches, leaving the explosive battery to perform its office of destroying whatever object it is driven into, as set forth."

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39. For an *Improvement in Ploughs;* W. W. Metcalf, York Springs, Adams county, Pennsylvania, October 17.

The patentee says,—"The nature of my invention consists in combining with any common plough, a lever which turns on a pivot, to clear away the straw, stubble, grass, or other obstruction which may, or usually does accumulate upon the front edge of the coulter, by a simple motion of the hand of the ploughman while the plough is progressing; instead of stopping it, and walking round to remove the obstruction by the hand or foot, which is the only way in which such obstructions can be removed from the common plough."

Claim.—"What I claim as my invention, is the combination of the lever with the plough; for the purpose of clearing obstructions from the coulter, whether the same be constructed, arranged, and operated as set forth, or in any other manner substantially the same.

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40. For an *Improvement in Presses;* David Dick, Meadville, Crawford county, Pennsylvania, October 17.

Claim.—"What I claim as my invention, is the combination of the two excentric wheels, with the centre wheel or roller, by which a double traverse of the follower is produced, by revolving the one centre wheel or roller. I also claim the combination of the excentric wheels, with the friction relieving sectors, all combined in the manner and for the purposes set forth.

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41. For an *Improvement in Flood Fences;* John A. Swope, Germany, Adams county, Pennsylvania, October 17.

The patentee says,—"The nature of my invention consists in such a construction that the action of the flood upon a lever shall throw loose the ends of the rails from the key posts, and then each released pannel, throw loose the next, and so on successively, until all the pannels are thrown loose; and in so attaching the rails that they may yield to and float with the current, whilst secured to the posts."

Claim.—"What I claim as my invention, is the mode of constructing a flood fence, so that the action of the flood, upon the arm of the lever shall release the rails, and that the opening one pannel, shall throw loose the

next pannel, and it the next, and so on successively, until all the rails shall be thrown loose; and they shall float with the current at the same time that they are securely attached to the posts."

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42. For an *Improvement in Planting Ploughs;* A. B. Earle, Colesville, Brown county, New York, October 17.

The patentee says,—"The nature of my invention consists in the construction of an instrument which I denominate a planting plough, because it performs the office of ploughing and planting at the same time, and in one machine."

Claim.—"What I claim as my invention, is the combination of the signal bell, or other like indicator with the valves to announce the exact time of depositing the seeds, substantially as set forth."

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43. For an *Improvement in Cultivators;* George Beeching, Augusta, Oneida county, New York, October 17.

Claim.—"What I claim as my invention, is, 1st, the construction of quadrangular teeth for cultivators, as set forth.

"2d, I also claim the construction of the U shaped iron brace having a clevis formed on its front, and two vertical transverse grooves on its sides, as combined with the adjustive standards.

"3d, I claim the extra handles for raising the cultivator in turning at the end of the furrow, or going over stones, &c. as set forth."

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44. For an *Improvement in Harness Saddle Mounting;* John J. Carrel, Petersburgh, Dinwiddie county, Virginia, October 17.

The patentee says,—"The nature of my invention consists in the method of constructing and attaching the water hooks, turrets, and screws, that are used on harness saddles, in such a manner as to prevent their injuring the horse's back, and at the same time strengthening the parts without, increasing their number or cost materially, the beauty of the mountings thereby being incidentally increased."

Claim.—"What I claim as my invention, is the method of connecting the turrets, water hooks, and screws with the harness saddle, by forming the female screw in the shanks of the turrets and water hook, and passing the male screw up from below into them, by which greater length of screw and strength is attained, and the liability of injuring the horse avoided, there can be also a saving of material in the pad, and of labor in manufacturing."

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45. For an *Improvement in Locking Umbrellas and Parasols;* G. F. Southwick, Somerset, Bristol county, Massachusetts, October 17.

Claim.—"What I claim as my invention, is a locking contrivance, as applied to or combined with an umbrella, and made to operate substantially as set forth."

46. For an *Improvement in Domestic Telegraphs;* John Russel, City of New York, October 17.

The patentee says,—"The nature of my invention consists in connecting the wires leading to the several rooms of the hotel or other building, to which the telegraph is applied, to a series of inclined levers combined with sliding bars, spiral springs, weighted levers, and suspended plates, marked with the several numbers of the rooms, with which the wires communicate, confined with a bell hammer and suitable mechanism for operating the same; and enclosed in a suitable case arranged conspicuously in the room of the clerk or servant whose duty it is to attend to the answering of the bell; in such a manner, that when a bell-pull of a room is drawn, the plate containing the number of the room in which the summons is made, will be caused to fall below the part of the case covering the same, and exposed to the view of the servant, and remain down until drawn up by him; and simultaneously with its descent, the hammer will be caused to strike the bell, to call the attention of the attendant to the number down, thus making one bell answer for all the rooms of the hotel or other building in which the apparatus is arranged, and exposing conspicuously to view the number of the room in which the bell-pull is drawn; so that should the attendant be absent at the time of the summons, the number will remain down until his return, and render a second summons unnecessary."

Claim.—"What I claim as my invention, is the particular combination and arrangement of the sliding bars, pall, bent levers, hammer, bell levers, tumblers, bars, springs and case, made with aprons, arranged at different levels and projections in the manner and for the purpose set forth, by which an alarm is given simultaneously with exposing the number, and causing it to remain exposed, until drawn in and concealed by the person summoned, or other person in attendance."

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47. For an *Improvement in Iron Hurdle Fence;* Matthias P. Coons, Lansingburg, Rensselaer county, New York, October 17.

Claim.—"What I claim as my invention, is the manner of constructing the fence, having bars of iron bent staple formed at their ends, so as to pass through mortises or holes, prepared in the posts to receive them, where they are secured in place by means of rods passed through the eyes of the said staples in the manner set forth. The upper fence bar also passing over pins at the upper ends of the posts, and the respective parts being combined with each other substantially as set forth; by which arrangement and combination, said fence may be speedily packed in a very small compass and readily restored to use."

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48. For an *Improvement in Door Springs;* Thomas Peck, Syracuse, Onondaga county, New York, October 17.

The patentee says,—"The nature of my invention consists in providing a cam rod or rail of triple curvature, and affixing it upon the lintel or frame above the door, and of affixing a spring on the door in combination with a traveling rod or arm, which has a grooved pulley on one end of the

same, which traverses the cam rod or rail previously referred to, and thereby graduates the power of the spring in acting upon the door, to close the door in a more simple and perfect manner than any heretofore known."

Claim.—"What I claim as my invention, is the peculiar formed cam rod or rail, in combination with the traveling arm and the pulley, for the purpose substantially set forth."

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49. For an *Improvement in Dentists' Instrument for Extracting Teeth;* Charles H. Dubs, Natchez, Adams county, Mississippi, October 17.

Claim.—"What I claim as my invention, is the combination of the notches of the screw, with the catch of the click, by means of which the screw affords additional power in extracting roots of teeth as set forth."

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50. For an *Improvement in Dentists' Drills;* Kirby Spencer, Athens, Clark county, Georgia, October 17.

Claim.—"What I claim as my invention, is, 1st, the combination of the hollow tapered tube, as a protecting case for the gearing, as set forth.

"2d, I claim the combination of the endless chain or belt, pulley, pinion, piston, propelling rod, segmental box, and segmental head with a hollow tapered tube, constructed in the manner set forth, for revolving the excavators, or rose drills, &c., for the purpose of excavating teeth angularly as set forth.

"3d, I claim the guide rail in combination with the tube as set forth."

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51. For an *Improvement in Manufacturing Artificial Flowers;* Caroline C. Nichols, Providence, Rhode Island, October 17.

Claim.—"What I claim as my invention, in the manufacturing an artificial flower, or the corolla thereof, is making the same of helix of floss silk, combined together, and with circular bases or pieces of cloth or paste board, substantially as set forth."

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52. For an *Improvement in Window Curtain Suspensions;* G. H. Marden, Charlestown, Middlesex county, Massachusetts, October 17.

The patentee says,—"The nature of my invention consists in providing an oscillating block or blocks on which the window shade is hung, as the said shade can be moved backwards and forwards on the roller on which it is fastened, so as to allow the window sash to be moved up the full length of its plane, and also to allow window shutters to close freely."

Claim.—"What I claim as my invention, is the metallic oscillating, or swinging blocks, as set forth."

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53. For an *Improvement in Cutting Files;* Nathan Starr, Middletown, Middlesex, Connecticut, October 17.

Claim.—"What I claim as my invention, is the combination of the cutters and drops with the revolving planes, by means of which the file blank is cut as it is advanced, by means of the feeding apparatus, composed of

an excentric, hand, ratchet wheel and screw, substantially as set forth. I also claim the combination of the lever, adjustable cutter, excentric, hand, and ratchet wheel and screw, the whole forming a machine for cutting and finishing a file."

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54. For an *Improvement in Lamps;* Samuel Rodman, New Bedford, Bristol county, Massachusetts, October 17.

The patentee says,—"My invention consists in an improvement on the argand lamps, which is in substituting for the tubular woven wick, a series of small wicks passing through perforations drilled in a heavy metallic tube, surrounding the central air tube."

Claim.—"What I claim as my invention, is the combination and arrangement of the heavy metallic tube or burner, having longitudinal perforations filled with a series of wicks, with the central air tube, substantially as set forth."

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55. For an *Improvement in Making Mills and Skeleton Dies for Printing;* Thomas Paton, Providence, Rhode Island, October 24.

Claim,—"What I claim as my invention, is my improved method of making the mill, the same consisting, 1st, in making on the die, and in incavo the bondage and a ground space without the ground figures; next in milling the entire curved surface of the mill, by a separate milling cylinder or tool; next, pressing and rolling the die and mill together, so as to sink or produce on the latter an impression of the bondage, and figure portions, and leave the entire ground of the mill in relief, as set forth."

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56. For an *Improvement in Saddles;* Robert Caldwell, Nashville, Davidson county, Tennessee, October 24.

The patentee says,—"The nature of my invention consists in the construction, arrangement, and attachment of the cantle so as to allow it to have a spring, and in strengthening the side bars at that point, and also in the manner of fastening the pads to the tree without nailing."

Claim.—"What I claim as new, is connecting the cantle with the side bars by means of plates, so that it is supported by springs and can move up and down, substantially as set forth. I also claim attaching the pad to the tree in the manner by means of the pocket loops, and without the aid of nails, as set forth."

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57. For an *Improvement in Cutting Irregular Forms in Wood;* D. George and H. Robertson, Granville, Licking county, Ohio, October 24.

Claim.—"What we claim as our invention, is the combination and arrangement of the mechanical devices, as set forth, attached to the reciprocating carriage for turning the pattern and piece of wood, to be shaped simultaneously, a segment of a circle at the end of each reciprocating movement of the carriage, with the cutters contained in the revolving cylinders arranged in the vertical swing frames attached to the main frame by which

the spoke, or other article to be shaped, will be dressed to a form approximating to that of the pattern, as set forth."

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58. For an *Improvement in Apparatus for Raising Water;* J. J. Vedder, Schenectady, New York, October 24.

The patentee says,—"The nature of my invention consists in applying friction rollers to turn the buckets to a proper position, and in a guard suspended over the spout to prevent the water from being thrown over, as the buckets are tilted, and lastly, the connected pawls or dogs to prevent accident while drawing water."

Claim.—"What I claim as my invention, is the guard plate, arranged substantially as set forth."

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59. For an *Improvement in Moulding Glass;* New England Glass Company, assignees of Jos. Magoun, Cambridge, Middlesex county, Massachusetts, October 24.

Claim.—"What I claim as new, is one or more lateral movable or retractive parts or pistons as combined with the remainder of the matrix, or stationary part of the mould and made to operate therewith, substantially as set forth."

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60. For an *Improvement in Boot Trees;* Jarvis Howe, Worcester, Worcester county, Massachusetts, October 24.

Claim.—"What I claim as my invention, is the combination of the swivel and turning journal and its bearing with the frame boot tree, and mechanicism for distending the parts of the leg, as set forth. I also claim the peculiar arrangement of the boot tree upon its supporting stand."

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61. For an *Improvement in Pessaries;* John R. Rowand, Philadelphia, Pennsylvania, October 24.

Claim.—"What I claim as my invention, is the thin, flat, broad, tapering elongation, or flap, descending from the bottom of the cup of the pessary, intended to occupy the uterus half (or more) of the vaginal canal, thereby more effectually to preserve the uterus (which reposes by its mouth or lips upon the cap) in situ; and also for such a combination of the flap, cup and perforation as are incidental to the flap pessary; using any appropriate substance for the construction of the instrument."

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62. For an *Improvement in Brick Presses;* James Dane, West Derby, Orleans county, Vermont, October 24.

Claim.—"What I claim as my invention, is the mode of discharging the filled moulds by means of a combined spring lever, cam shaft, curved discharging arm, and treadles, arranged and operating in the manner and for the purpose set forth."

63. For an *Improvement in Ships Lights;* Enoch Hidden, City of New York, October 24.

Claim.—"What I claim as my invention, is securing the caoutchouc by baking and compression in the creased groove of the casing, to form an elastic seat for the glass frame to be shut down and compressed upon, to make a water tight joint."

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64. For an *Improvement in Lamp Tops;* Seth E. Winslow, Kensington, Philadelphia county, Pennsylvania, October 24.

The patentee says,—"The nature of my invention consists in providing a lamp top with two wick holders, one holding a wick which extends down to the fluid contained in the lamps, resting upon or within a ledge contained in the lower half of the lamp top, or resting on the lamp within the said half. And the other wick holder made in the usual form, but so enlarged as to hold a quantity of wick which in being screwed down brings the wick in contact with the wick of the lower wick holder, making one continuous wick. The said upper wick holder can be removed when it is lighted, and be used as safely as any other lamp, to give light during the refilling of the lamp."

Claim.—"What I claim as my invention, is the manner of employing the separate wicks as set forth, so that when filling the lamp the lighted portion of the wick may be removed and avoid the risk of explosion."

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65. For an *Improvement in Drilling Rock;* Matthias P. Coons, Lansenburg, Rensselaer county, New York, October 24.

Claim.—"What I claim as my invention, is the particular manner set forth of constructing the grippers, and combining them with the latch lever, and with the slide, under an arrangement of parts, substantially as set forth. I also claim the particular manner in which I give a rotary motion to the drill shaft, by means of the rod, extending from the standard as described."

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66. For an *Improvement in Machines for Creasing Leather Straps;* Samuel Cronce, Flemington, Hunterdon county, New Jersey, October 24.

Claim.—"What I claim as new, is the particular manner in which I have arranged and combined the respective parts; that is to say, I claim, in combination, the adjustable creasing rollers on the shaft, the roller, and the guide strips, so as to co-operate in effecting the purpose made known."

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67. For an *Improvement in Horse Rakes;* Eli Saunders, Weatherfield, Windsor county, Vermont, October 24.

Claim.—"What I claim as my invention, is the manner of applying the counterbalance box, (viz. by affixing it to arms or other proper contrivances projecting directly from *the rake head frame, and over and in front of the axle,*) in combination with the manner of sustaining the rake head, that is to say, by a rocker to rest, and rock upon the axle, as set forth; the said improvement taking off all downward strain of the counterbalance on the

shafts and back of the horse, and thereby enabling the animal to work to better advantage than he could were the weight of the counterbalance or any part thereof to be thrown on him. Besides this the simplicity of the machine, and ease of operation of it, renders it superior and less costly in construction than most others of the kind in common use."

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68. For an *Improvement in Wire Fences;* Zephaniah Knapp, Pittston, Luzerne county, Pennsylvania, October 24.

The patentee says,—"My improvement consists in providing a means of securing the horizontal wire rods of the fence to the vertical posts of the same, of such a nature as to firmly connect them where they intersect each other, and draw the wire rods taut, and allow of the wires being withdrawn when it is desired to replace a broken wire, or for other purposes."

Claim.—"What I claim as my invention, is the mode of securing the wires to the posts, and straining them between the same by means of wedges or keys driven into mortices or slots, formed in the posts, above the wires, and causing them to be bent downwards into the lower parts of said mortises or slots, as set forth, whether said slots be formed at right angles to the wires, or parallel with the same. I also claim the combination of the oblong keys, having cogs or protuberances on their lower edges, and keys above the same, and longitudinal mortises or slots in the posts with the wires running parallel with the same, as set forth."

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69. For an *Improvement in Working Lock Gates by Water Power;* Lyman P. Judson, assignee of J. D. Willoughby, Susquehanna Post Office, Dauphin county, Pennsylvania, October 24.

Claim.—"What I claim as my invention, is, 1st, opening and closing the gates and wickets of canal locks, by the power of the waste water, applied by means of a combination of over shot wheels, affixed to horizontal shafts, having the buckets of every alternate wheel arranged in opposite directions for the purpose of reversing the motion of the wheels for opening and closing the gates, said wheels being made to act upon the gates through the agency of a combination of cog wheels, shafts, rack rods, pinions, cranks, and rods, arranged and operated as set forth.

"2nd. I claim the combination of the revolving shaft, cams, cranks, cords, with the levers, gates, and floom, for letting the water on to the wheels; the several parts being arranged in the manner and for the purpose substantially as set forth."

"3rd. I claim the combination of the vertical shaft and cogged wheels, and the racked bars with the cog wheels, pinions, cogged stems attached to the wicket gates for opening and closing the main gates, and the wicket gates therein, by the turning of the water wheels, as set forth.

"4th. I also claim the combination of the crank rods and connecting rods with the cog wheels, rack rods, and shaft, turned by the water wheels for opening and closing the lower gates and their wickets, as set forth.

"5th. I likewise claim the combination of the rods with the gates and cranks for turning the cam shaft, by the opening and closing of the gates to which the rods are attached, as set forth."

70. For an *Improvement in Shingle Machines;* John Turner, St. Albans, Somerset county, Maine, October 31.

Claim.—"What I claim as my invention, is the dogs operated by the gate or carriage, in combination with the knives and cutting gauges, as arranged and set forth."

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71. For an *Improvement in Fastenings for Pantaloon Straps, &c.;* W. W. Riley, Columbus, Franklin county, Ohio, October 31.

The patentee says,—"The nature of my invention consists in constructing a snap or catch in such manner, as when adapted and designed for pantaloons, one part can be sewed or buttoned on to the pantaloons, and the other by *pressure* fastened and unfastened at the will and control of the wearer, both parts adapting themselves without liability to injury by bending to any required form or position of the foot, and permitting as free use of the ancle as any other strap now in use."

Claim.—"What I claim as my invention, is the instrument as described for pantaloons, and the principle for use in the connexion of bracelets, gold chains, and other articles of dress and military trappings."

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72. For an *Improvement in Water Doors for Steam Boilers;* Isaac W. Ayres, City of New York, October 31.

Claim.—"What I claim as my invention, is the water door, so arranged as to have a continuous circulation passing through it, in combination with steam boilers or furnaces; and I also claim the mode of connecting the same to the head of a steam boiler or furnace, in the manner and for the purposes set forth."

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73. For an *Improvement in Insulating Supports for Telegraph Wires;* L. R. Livingston, J. J. Roggins, and Calvin Adams, Pittsburgh, Allegheny county, Pennsylvania, October 31.

Claim.—"What we claim as our invention, is our improved insulating supporter for telegraph wires; composed of the metallic supporter, the glass insulator, and the roof, combined with each other and with the post, substantially in the manner set forth."

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74. For an *Improvement in Cooking Utensils for Boiling and Steaming;* James Stevens, Middletown, Frederick county, Maryland, October 31.

Claim.—"What I claim as my invention, is constructing culinary vessels for boiling or steaming, with two projecting bottoms or heating surfaces, on adjacent sides, so that by merely changing its position the vessel is converted from a boiler to a steamer, or from a steamer to a boiler, as set forth."

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75. For an *Improvement in Looms;* James Haworth and John Haworth, near Frankford, Philadelphia county, Pennsylvania, October 31.

Claim.—"What we claim as our invention, is, 1st. The combination and

arrangement, and organization, and operation of mechanism for stopping the loom when the filling or weft breaks, said combination consisting of the forked finger that rests against the filling when not broken, and which passes through the grating in the lay when the filling breaks, and causes the loom to stop; the short rock shaft to which the forked finger is affixed, arm, connecting rod, arm, finger shaft, finger, and spring, in combination with the stop lever, against which the finger strikes, causing the lever to turn on its fulcrum, and actuate the belt shipper for casting off the belt from the fast to the loose pulley, and thus stop the loom.

"2nd. We also claim the combination, and arrangement, and operation of the before described mechanism for actuating the picker staves, for throwing the shuttles without the use of picking treadles, straps, and other appendages usually employed for such purposes, said combination consisting of forked rock shafts, to which the picker staves are connected, the short axles passing through the picker staves into the forks of the rock shafts; the T shaped bars attached to the rock shafts and the rollers on the cranks, projected from the shafts for turning the rock shafts, alternately, as set forth; the picker staves being free to turn in the arc of a circle, in the direction of the movement of the lay, as well as in the direction of the throws of the shuttle simultaneously."

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76. For an *Improvement in Flyers for Roving Cotton;* Thomas Marques, City of New York, October 31.

The patentee says,—"My improvement consists in a seat and guide fitted to the leg of the flyer of the machines, for roving and slubbing cotton, so as to conduct the sliver and afford any required pressure upon the bobbin, without the intervention of a spring or springs."

Claim.—"What I claim as my invention, is the mode of moving and pressing the guide of the flyer (of a machine for roving and slubbing cotton) inwards so as to conduct the sliver to the bobbin without the use of springs, as set forth."

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77. For an *Improvement in Hanging Runner Stones in Mills;* Nathaniel Oakley, Babylon, Suffolk county, New York, October 31.

Claim.—"What I claim as my invention, is the balancing of runner mill stones, when at rest or in motion, by the introduction of a metallic ring as set forth, in combination with the improved form of the rynd or suspending bar and the mode of adjusting and fixing it in the eye of the runner stone, together with the mode of connecting the driver to the suspension bar, all as set forth."

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78. For an *Improvement in Hand Drills;* Stephen B. Crum, assignee of John Johnson, Somerville, Middlesex county, Massachusetts, Oct. 31.

Claim.—"What I claim as my invention, is the friction bands or clasps (or an equivalent spring band) and the toggle, in combination with the lever and its arms, and the drill stock, the whole being arranged, constructed and made to operate together, substantially as set forth."

79. For an *Improvement in Alloys for Sheet Metals;* Timothy D. Jackson, Brooklyn, Kings county, New York, October 31.

The patentee says,—"The materials employed by me in making this alloy are as follow:—Take of copper 64 ounces, zinc 22 to 26 ounces, india tin 1 to 4 ounces."

Claim.—"What I claim as my invention or discovery, is the application of the manipulations employed for compounding an alloy of metals in the proportions and of the materials mentioned for a new sheet metal, which shall be capable of being wrought in the cutting press, with dies &c., substantially as set forth."

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80. For an *Improvement in Shoe Pegging Machines;* Joel Robinson, Methuen, Essex county, Massachusetts, October 31.

Claim.—"What I claim as my invention, is, 1st, holding the shoe on rocking, turning, or moving stocks, in the proper position to be pegged, whether the same be constructed, arranged, and operated as set forth, or in any other manner substantially the same.

"2nd. I also claim the simultaneous intermittent movement of the carriage and stock, by means of the cogged and grooved guide pattern and transversing guide shaft and pinion, for the purpose of arranging the pegs at uniform distances apart in lines round the sole of the shoe, and parallel to its edge, whether the same be constructed, arranged and operated in the manner set forth, or in any other substantially the same. I also claim the employment of the turning tube for the purpose of receiving the pegs from the charger, and then placing them over the holes punctured in the sole of the shoe by the awl, in the proper position to be driven therein, whether the same be made and operated as set forth, or in any other way substantially the same. I also claim the manner of supplying the turning tube with pegs from the charger, at suitable intervals, by means of a vibrating driver, as set forth. And lastly, I claim the employment of a spiral chamber or groove to contain the pegs, and supply them to the charger, one at a time, by the simultaneous intermittent action of the traversing pusher and ratchet wheel, or otherwise, in combination with the charger, driver, turning tube, awl, and punch, arranged and operated in the manner and for the purpose set forth. And I wish it to be distinctly understood that I do not claim the spiral chamber, nor its use as a supplier, as it has been used for percussion caps in fire arms, provided with a transversing pusher similar to mine, but I merely claim its employment, in combination as set forth, for supplying pegs for pegging shoes."

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81. For an *Improvement in the Manufacture of Alkaline Chromates;* Richard A. Tilghman, City of Philadelphia, Pennsylvania, October 31.

Claim.—"I claim as my invention making the chromates of potash and soda, by exposing a mixture of the sulphates or muriates of those alkalies respectively with chrome ore, and either with or without lime, at a red heat to a current of steam and an oxidizing atmosphere. I do not claim making the chromates of potash and soda by heating together the sulphate of potash or soda, chrome ore and lime without the use of steam. I also

claim making the chromate of potash, by heating to redness a mixture of a potash felspar, lime or its carbonate, and chrome ore in an oxidizing atmosphere. I also claim making the chromates of baryta and strontia by exposing a mixture of the sulphates or muriates of those bases respectively with chrome ore, at a high heat, to a current of steam and an oxidizing atmosphere."

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82. For an *Improvement in Saw Mills;* William Fink, Williamsport, Lycoming county, Pennsylvania, October 31.

Claim.—"What I claim as my invention, is, 1st, the method of changing the motions of the carriage to feed or gig back by the employment of the transverse sliding frame, containing the feed hands, and tappet wheel and pinion, which latter traverses the lines of cogs on the head and tail blocks, and those on the side of the carriage for resetting the log, which feed hands advance the carriage to the saw, whilst the motions of the saw and carriage are continuous and uninterrupted, except by momentary pauses, consequent upon engaging the pinion with the racks of the tail blocks and carriage, and disengage it from the rack of the head block, as set forth.

"2nd. I also claim the combination of the double excentrics on the levers with the single excentrics for moving the slide to which the log is dogged to the right or to the left, by inclining the lever to the right or to the left, and causing the arm of the transverse sliding frame to actuate the excentric, previously to the reversing the movement of the carriage, and whilst the saw is in the groove of the head block, for setting the log at the head block.

"3rd. I claim the employment of the shaft, pinion, and tappet, cog wheel, and arm, in combination with the main shaft for operating the carriage and transverse sliding frame, and other parts, as set forth.

"4th. I claim the employment of the transverse sliding frame in combination with the propelling shaft, pinion, and racks for setting the log on the head block, and changing the motion of the carriage, as set forth.

"5th. I claim the method of adjusting the rack for the purpose of leaving a stub short on the boards, by bringing the rack into gear with the pinion, before the saw has passed through the log, and also the method of sawing boards *without* stub short, by bringing the rack into gear with the pinion, after the saw has passed through the log and entered the groove of the *tail* block, effected by moving the slide towards or from the saw, and securing it permanently to the tail block by the pin, which is inserted into a hole in the slide.

"6th. I claim the employment of the shield in combination with the ratchet bar and carriage, for preventing the action of the feed hands upon the carriage during the operation of setting large logs by hand."

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83. For an *Improvement in Hydraulic Apparatus for Transmitting Power;* David Hinman, Brunswick, Medina county, Ohio, October 31.

Claim.—"What I claim as my invention, is the method substantially as set forth, of transmitting power from any one point to another, by means

of the two vibrating rings with the two columns of water interposed, substantially as set forth."

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84. For an *Improvement in Wagons;* John Mills, Pitt Township, Allegheny county, Pennsylvania, October 31.

Claim.—"What I claim as my invention, is the use of the strips to support the body of the wagon off the wheels, in combination with the cams to elevate and lower the wagon body off the wheels and running gears, substantially in the manner set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

An Essay on the Physics of Steam. By THOS. PROSSER, C. E., *New York.*

The object in view in the following remarks, is to elucidate some of the mysterious actions of steam, but more particularly in reference to its economic value as a motor, in the steam engine, when working expansively.

It has not, therefore, been thought desirable, to make the title cover more ground, for instance, the electricity and electro chemical operations of steam, which may be incidentally touched upon, merely to connect with, but not to explain, which must be left until another time, and it may be to abler hands.

Reasoning "by analogy," has probably been the cause of as much erroneous doctrine in the church, as any other thing which can be named, and so long as the churchmen were the principal depositaries of science, it was to be expected that this same source of error would be carried there also, but their science was principally of the speculative kind; and yet, we find grave professors of the exact sciences of the present day, with the old abomination of substituting fancy for fact. I will instance the fact of high pressure steam not scalding the hand. The explanation given in the books, to account for this phenomena is, "by analogy," the production of cold by expansion. It is admitted that low pressure steam will scald, and therefore the "analogy" will not hold good, unless the cold produced is lower than the temperature of such steam; accordingly we find a writer in this journal, who puts it at 88°; *(Vol.* XII. *3d series, p.* 193;*)* he says that steam at 360° F. "expanded to the atmosphere should be 88°. It would therefore rush into the air, and immediately assume the form of water." Now as it appears to me, the very reverse of this is the fact, that is to say, the steam will not condense, and assume the form of water, in consequence of the expansion, and hence, it will not scald the hand.

When steam is generated under the pressure of the atmosphere into which it is permitted to escape, whatever of electricity may be evolved is conveyed back to the water from which it was generated, in consequence of the conducting power of such steam, and the hand which is placed in it becomes scalded; because such steam having no power of expansion, must instantly condense on any substance colder than itself which may be

presented to it; but the air, if fully saturated with moisture at the time, will not take up a particle of it, and therefore it must fall down in a fine shower as rapidly as the particles of air and steam come in contact with each other, and the temperature at the instant of condensation of the steam will be scarcely less than 212°, although it will almost instantly assume that of the air through which it falls, and which continually presents fresh cool air to its finely divided particles. The insensible or latent heat which it has given out, from the state of vapor to become water, will amount to 1000° or six times as much as would raise the temperature of the same weight of water 167°.

High pressure steam, on the other hand, is almost the very reverse of this, in every particular except the last, that is to say, the same weight of steam will raise the temperature of a given weight of water in the same degree, whatever may be the pressure of the steam. This is commonly known as the law of Watt, and has been proved experimentally by M. Clement and others; and although the recent laborious experiments of M. V. Regnault show that it is not correct, it is nevertheless likely to maintain its position among practical men, on account of its simplicity and sufficient accuracy for ordinary purposes. The experiments of Pambour are said to confirm the law of Watt, inasmuch as steam, "under an absolute pressure varying from 2·7 to 4·4 atmospheres, and escaping into the atmosphere under an actual pressure of from 1·4 to 1·03 atmospheres, presented at its issue exactly the same temperature, as though it were saturated."

These experiments, however, appear to me as proving just the contrary, and support M. V. Regnault's experiments, although it appears to have been entirely overlooked.

If steam after expansion presents the same temperature that is due to saturated steam, at the pressure under which it is expanded, then it is clear that such steam is not saturated but surcharged, because it is a well settled fact, that the density of steam does not increase in so high a ratio as its elasticity, and hence the temperature of expanded steam being higher than is due to the quantity of water it contains, proves that the total heat must be greater in high than in low pressure steam. To give a familiar example, take 100 cubic inches of steam at the pressure of the atmosphere, the temperature 212° F., the weight will be 14·9620 grains, take now also 50 cubic inches at twice that pressure, the temperature will be 250·52° Farh., but the weight will be only 14·1376 grains.

Again, the weight of 100 cubic inches of steam at 4 atmospheres pressure is 53·2574 grains, temperature 293·72°; expanded into 4 volumes, 100 cubic inches will weigh 13·31435 grains, the temperature due to which as saturated steam is 205°, and the pressure ·8633 atmosphere; such must be the result if the law of Watt be true, but the experiments of Pambour, before alluded to, show that such steam will issue into the atmosphere, at the temperature of 212° Fahrenheit, notwithstanding the cooling it must experience, in passing through the engine, and the improbability of its having entered it perfectly dry.

But one conclusion appears possible, the high pressure steam contains the most heat; during expansion, the surplus heat goes to surcharge the

steam, and make it "dry," and like hot air at a high temperature, the hand may be held in it with impunity.

According to M. V. Regnault, at 212° the total heat of steam is 1146·60, at 205° it is 1142·57, and at 293·72° it is 1170·72. We have therefore about 28° of heat in steam when expanded four times, more than is due to the water which it contains; the temperature therefore becomes 233° instead of 205°, and the pressure 1·0246 instead of ·8633 atmosphere; no cold is therefore produced by the expansion of steam, as is the case with air. The capacity of high pressure steam for heat, is greater than that of a lower pressure, which is just the reverse of air, and the gases generally. Steam, therefore, will not bear compression, because it does not contain a sufficiency of heat under a low pressure, to supply the demands of a higher one; and now having arrived at two of the causes which render the working of steam expansively so economical in the Cornish, or any other working by expansion and at a slow speed, viz. the surcharged state of expanded steam, and the liability to condensation by pressure of saturated steam, I close the present chapter, as I hope without having scalded my hand.

Report on the Gases evolved from Iron Furnaces, with reference to the Theory of the Smelting of Iron. *By* Prof. Bunsen, *of Marburg, Hesse Cassel, and* Dr. Lyon Playfair, *of the Museum of Economic Geology, Department of Her Majesty's Woods and Forests.*

From the Report of the British Association for the Advancement of Science, for 1845.

(Continued from page 32.)

Theory of the Hot Blast Furnaces.

The previous inquiries have led us to a knowledge of the average composition of the furnace-gases, as they are produced during the processes in operation in various parts of the furnace. We have endeavored to point out the influence exerted on the average composition of the gases by the materials introduced into the furnace, the ultimate products of all of which changes appear at the mouth of the furnace. We now proceed to the most important part of our inquiry, by endeavoring to elucidate the nature and mutual relation of all the processes in the reduction of iron. To obtain a knowledge of them, it was necessary to become acquainted with the changes suffered by the ascending column of air from the blast to the mouth of the furnace. We have collected the gases from various depths of the furnace, in the manner employed by one of us in his inquiries into the theory of German furnaces in which charcoal is used as fuel. This method has been more lately used by Ebelmen, with several changes which we have been compelled to reject, because in them he introduced a source of error which vitiated his results.

The apparatus for collecting the gases in our experiments consisted of a system of tubes, twenty-six feet in length, made of soft malleable iron. The tube was one inch in diameter, and consisted of pieces of five feet in

length, screwed together so as to be air tight. The depth of the tube in the furnace was known by white marks placed at the distance of one foot, and we found that about three of these sunk in an hour during the first part of the experiment, although more slowly afterwards. The top part of the tube was furnished with a lead pipe, through which the gases were conducted to a place fit for experiment. The system of tubes was balanced by a chain passing over a block fixed to a stout wooden upright, and fastened by chains round the furnace. The strong heat of the flame issuing from the top of the furnace rendered it necessary to wet the support from time to time, and this was effected by a fire-engine placed at some distance on the platform. The gases themselves were collected in glass tubes, four inches long and $\frac{3}{4}$-inch wide, these tubes being drawn out at both ends and connected with each other, and also with the lead tube, by caoutchouc joints. The pressure of the gas, which often amounted to several inches of water, was too powerful to allow the glass tubes to be hermetically sealed while they remained in connexion with the lead pipe. We therefore found it necessary to heat the tubes, so as to expand the air to a certain extent, then to tie the caoutchouc joints, and not to seal the tubes hermetically until they had cooled down sufficiently to prevent any small explosion during the melting of the glass. A vertical section of the furnace upon which our experiments were made is represented in fig. 6; it of the usual size of furnaces in this country, and is supplied with air heated to 626° Fahr., 330° C. This air passes into the furnace under a pressure of mercury of 6·75 inches, out of a nozzle of 2·75 inches in diameter. The iron ore melted in this furnace is an aluminous sphareosiderit, which is previ ously roasted so as to free it from moisture and carbonic acid, and by this means is converted into argillaceous peroxide of iron. The furnace is supplied with eighty charges in the course of twenty-four hours; each of these charges, as we have already mentioned, consisting of 420 lbs. of calcined ironstone, 390 lbs. of coal, and 170 lbs. of limestone, the product of which is 140 lbs. of pig iron. The limestone is broken up into pieces about the size of the fist before being introduced into the furnace, but the coal and ironstone are projected in lumps which not unfrequently weigh above 20 pounds. Iron ore and limestone are thrown into the furnace without any previous mixture. We have collected the gases in all the regions below and above the zone of fusion, for in the latter the collection was impossible, owing to the high temperature, which softened the tubes, or melted them completely. Although the gases under the zone of fusion are actually at a higher temperature than they are at that point of the furnace, we succeeded in obtaining them by boring through the *Front* over the hearth of the furnace, and introducing an iron tube.

The gases collected over the zone of fusion were first examined, and gave the following results:—

Experiment I.

The depth of the tube was five feet below the upper stratum of fuel and materials. The gases issuing from the tube possessed a peculiar smell, different to that of coal gas, but very similar to the characteristic odor of acrolein; they burned with a yellowish red flame, but were not accompanied with brown vapors of tar. Number of charges, 6.

A. *Estimation of Olefiant Gas and Carbonic Acid.*

	Volume.	Pressure.	Temp.	1 m. at 0° C.
Gas used	132·0	0·6558	12°·0	82·93
After absorption of olefiant gas	131·5	0·6550	11·8	82·57
After absorption of carbonic acid	122·4	0·6471	11·0	76·13

B. *Examination of the Gas freed from Olefiant Gas and Carbonic Acid.*

Gas used	125·2	0·4626	11·0	55·67
After admission of O	205·8	0·5452	11·3	107·74
After combustion	179·6	0·5168	11·1	89·20
After absorption of CO_2	149·7	0·4946	10·0	71·17
After admission of H	321·6	0·6537	11·0	202·09
After combustion	179·6	0·5172	11·0	89·29

Nitrogen	55·35	Hydrogen	6·73
Carbonic acid	7·77	Olefiant gas	0·43
Carbonic oxide	25·97		
Light carburetted hydrogen	3·75		100·00

Experiment II.

The depth of the tube was eight feet. The blast had been interrupted for a whole hour previous to the experiment, but the gases were not collected until the furnace had been for some time in tranquil action. The flame and smell were exactly the same as in the first experiment. Number of charges, 14.

A. *Estimation of Olefiant Gas and Carbonic Acid.*

	Volume.	Pressure.	Temp.	1 m. at 0° C.
Gas used	105·4	0·6254	11°·0	63·36
After absorption of olefiant gas	104·6	0·6248	11·0	62·82
After absorption of carbonic acid	95·5	0·6173	10·1	56·85

B. *Examination of the Gas freed from Olefiant Gas and Carbonic Acid.*

Gas used	125·4	0·4623	10·5	55·83
After admission of O	211·9	0·5680	11·0	115·70
After combustion	185·5	0·5221	11·0	93·10
After absorption of CO_2	155·3	0·5032	10·0	75·39
After admission of H	344·8	0·6767	10·5	224·36
After combustion	195·5	0·5342	10·9	100·43

Nitrogen	54·77	Hydrogen	6·49
Carbonic acid	9·42	Olefiant gas	0·85
Carbonic oxide	20·24		
Light carburetted hydrogen	8·23		100·00

Experiment III.

The depth of the tube in the furnace was eleven feet, and the gases evolved were accompanied by vapor of tar, and possessed the smell of

coal gas. The flame was of a clear yellow, with a strong illuminating power. The number of charges was twenty-three.

A. *Estimation of Carbonic Acid and Olefiant Gas.*

	Volume.	Pressure.	Temp.	1 m. at 0° C.
Gas used	108·3	0·6377	9·0°	66·86
After absorption of olefiant gas	107·6	0·6357	9·0	66·22
After absorption of carbonic acid	98·8	0·6274	9·4	59·93
B. *Examination of the Gas freed from Olefiant Gas and Carbonic Acid.*				
Gas used	131·0	0·4773	9·4	60·45
After admission of O	218·9	0·5639	9·4	119·33
After combustion	186·4	0·5322	9·4	95·90
After absorption of CO_2	155·7	0·5126	9·3	77·19
After admission of H	290·2	0·6336	9·3	177·82
After combustion	119·9	0·4540	9·5	52·60

Nitrogen	52·57	Hydrogen	9·33
Carbonic acid	9·41	Olefiant gas	0·95
Carbonic oxide	23·16		
Light carburetted hydrogen	4·58		100·00

Experiment IV.

The depth of the tube in the furnace was fourteen feet; the number of charges twenty-six; the smell of the gases was ammoniacal and tarry; vapors of tar were visible, and the flame was yellow, but of small illuminating power.

A. *Estimation of Olefiant Gas and Carbonic Acid.*

	Volume.	Pressure.	Temp.	1 m. at 0° C.
Gas used	124·2	0·6462	7·5°	78·12
After absorption of olefiant gas	121·0	0·6529	7·5	76·89
After absorption of carbonic acid	111·5	0·6430	7·5	69·78
B. *Examination of Gas freed from Olefiant Gas and Carbonic Acid.*				
Gas used	147·2	0·4956	7·5	71·01
After introduction of O	232·6	0·5800	7·5	131·31
After combustion	188·4	0·5363	7·7	98·27
After absorption of CO_2	156·1	0·5108	7·4	77·63
After introduction of H	291·6	0·6361	7·7	180·40
After combustion	144·0	0·4927	7·7	69·00

Nitrogen	50·95	Hydrogen	12·42
Carbonic acid	9·10	Olefiant gas	1·57
Carbonic oxide	19·32		
Light carburetted hydrogen	6·64		100·00

Experiment V.

Depth of the tube in the furnace seventeen feet; thirty-two charges; the stream of gas, which had been interrupted for a short time, possessed a peculiar tarry smell. There were no vapors of tar, and the flame was yellow and only slightly illuminating.

A. *Estimation of Carbonic Acid and Olefiant Gas.*

	Volume.	Pressure.	Temp.	1 m. at 0° C.
Gas used	114·5	0·6414	11°·6	70·45
After absorption of olefiant gas	113·0	0·6412	11·7	69·48
After absorption of carbonic acid	99·0	0·6320	10·9	60·72
B. *Examination of the Gas freed from Olefiant Gas and Carbonic Acid.*				
Gas used	125·5	0·4740	12·0	56·99
After admission of O	213·4	0·5615	11·8	114·86
After combustion	186·2	0·5345	11·8	95·40
After absorption of CO_2	160·7	0·5197	11·5	80·14
After admission of H	332·6	0·6784	11·7	216·38
After combustion	171·4	0·5237	11·8	86·04

Nitrogen	55·49	Hydrogen	7·62
Carbonic acid	12·43	Olefiant gas	1·38
Carbonic oxide	18·77		
Light carburetted hydrogen	4·31		100·00

Experiment VI.

Depth of the tube twenty feet; thirty-eight charges. The gases were not accompanied by vapors of tar, they smelt ammoniacal and burnt with a pale blue flame.

A. *Estimation of Olefiant Gas and Carbonic Acid.*

	Volume.	Pressure.	Temp.	1 m. at 0° C.
Gas used	96·2	0·7284	12°·3	67·05
After absordtion of olefiant gas	96·2	0·7274	12·1	67·01
After absorption of carbonic acid	87·0	0·7175	12·2	59·75
B. *Examination of the Gas freed from Olefiant Gas and Carbonic Acid.*				
Gas used	113·9	0·4586	12·2	50·00
After admission of O	213·0	0·5590	12·7	113·78
After combustion	192·8	0·5391	12·7	99·32
After absorption of CO_2	169·8	0·5285	12·1	85·93
After admission of H	335·5	0·6777	12·7	117·27
After combustion	130·7	0·4890	12·2	61·18

Nitrogen	60·46	Light carburetted hydrogen	4·40
Carbonic acid	10·83	Hydrogen	4·83
Carbonic oxide	19·48		
			100·00

Experiment VII.

Depth of the tube twenty-three feet; forty-two charges. The gas was unaccompanied by tarry vapors, but smelt slightly, although distinctly, of cyanogen, and burnt with a pale blue flame of no illuminating power.

A. *Estimation of Olefiant and Carbonic Acid Gases.*

	Volume.	Pressure.	Temp.	1 m. at 0° C.
Gas used	121·6	0·6517	8·0	77·02
After absorption of olefiant gas	121·6	0·6517	8·0	77·02
After absorption of carbonic acid gas	113·0	0·6441	8·0	70·71

B. *Examination of the Gases freed from Olefiant Gas and Carbonic Acid.*

Gas used	134·9	0·4817	8·0	63·14
After admission of O	230·9	0·5770	8·0	129·46
After combustion	208·9	0·5560	8·0	112·86
After absorption of CO_2	180·1	0·5312	7·3	93·18
After admission of H	333·6	0·6720	7·7	218·03
After combustion	127·7	0·4730	7·8	58·75

Nitrogen	58·25	Light carburetted hydrogen	1·64
Carbonic acid	8·19	Hydrogen	4·92
Carbonic oxide	26·97		100·00

Experiment VIII.

Depth of the tube twenty-four feet; the number of charges and character of the gases were the same as in the last experiment.

A. *Estimation of Olefiant and Carbonic Acid Gases.*

	Volume.	Pressure.	Temp.	1 m. at 0° C.
Gas used	141·8	0·6562	10·9	89·48
After absorption of olefiant gas	141·8	0·6562	10·9	89·48
After absorption of carbonic acid	128·3	0·6523	11·0	80·46

B. *Examination of the Gases freed from Olefiant Gas and Carbonic Acid.*

Gas used	139·7	0·4792	11·0	64·36
After admission of O	207·9	0·5479	11·0	109 50
After combustion	181·6	0·5215	11·0	91·05
After absorption of CO_2	148·1	0·5011	11·0	71·35
After admission of H	286·3	0·6267	11·2	172·36
After combustion	164·6	0·5075	11·5	80·16

Nitrogen	56·75	Light carburetted hydrogen	2·33
Carbonic acid	10·07	Hydrogen	5·65
Carbonic oxide	25·10		100·00

The gas which we collected within two feet nine inches of the tuyère, possesses such a remarkable composition that we are obliged to devote to it particular attention. The gases, although collected only two feet nine inches above the entrance of air, are entirely free from oxygen, and, what is still more remarkable, do not contain a trace of carbonic acid. Olefiant gas and light carburetted hydrogen could not be present, as the gases produced in the region of the furnace are evolved from materials long exposed to a white heat. Cyanogen, however, was found in the gaseous mixture in such quantity as to be quite sensible by its smell, and by giving the flame its characteristic purple color.

The analysis of the mixture was effected in the same manner as in the preceding cases, but it is necessary to use the following equations in the calculation of its composition.

We call the quantity of gas used in the analysis A, the quantity of its constituents hydrogen, carbonic oxide, cyanogen, and nitrogen, respectively x, y, z, n; and designate the oxygen used in the combustion as O, and that remaining after combustion as p, and the volumes of gas remaining after the combustion, and then after the absorption of the carbonic acid, as B and C; we then obtain the following expressions:—

$$A = x+y+z+n.$$
$$B = O+n+z+\tfrac{1}{2}y-\tfrac{1}{2}x.$$
$$C = O+n-z-\tfrac{1}{2}y-\tfrac{1}{2}x.$$
$$O-p=\tfrac{1}{2}x+\tfrac{1}{2}y+2z.$$

The values of the unknown quantities deduced from these quotations are:

$$x=O-B+\frac{(C-p+A),}{2}$$
$$y=B-O+\frac{(A-3C+3p),}{2}$$
$$z=\frac{C-A+2O-3p,}{4}$$
$$n=\frac{3C-p+A-2O.}{4}$$

The gas collected six feet above the hearthstone of the furnace, and two feet nine inches above the tuyère, gave the following results by eudiometric analysis:—

	Volume.	Pressure.	Temp.	1 m. at 0° C.
Gas used	141·3	0·4935	8·5°	67·63
After admission of O	180·1	0·5323	8·5	92·98
After combustion	156·5	0·5083	8·7	77·10
After absorption of CO_2	110·1	0·4688	9·0	49·97
After admission of H	199·2	0·5493	9·0	105·93
After explosion	155·7	0·5077	9·0	76·53

The composition of this gas, calculated out of the preceding numbers by the equations just given, is—

Nitrogen	58·05
Carbonic oxide	37·43
Hydrogen	3·18
Cyanogen	1·34
	100·00

If we calculate the proportion of the nitrogen (including also that in the cyanogen) to the oxygen contained in the gas, after subtracting a quantity corresponding to the hydrogen, we obtain the numbers 79·2 : 22·8, which differ only 2 per cent. from the quantity of oxygen in atmospheric air. Now, by calculating this gaseous mixture on the supposition that it does not contain cyanogen, and consists merely of nitrogen, carbonic oxide, carburetted hydrogen, and hydrogen, using the formulæ which we have provided for such cases, the following composition would result, which is not admissible under the circumstances in which the gas is formed:—

Nitrogen	59·39
Carbonic oxide	38·33
Carburetted hydrogen	1·79
Hydrogen	0·49
	100·00

Hence this calculation leads us to a composition in which nearly 2 per cent. of light carburetted hydrogen is present, an assumption which at once proves its inaccuracy, when we consider the point of the furnace at which the gas was collected. A consideration of the previous analysis explains the change suffered by the column of air in its ascent in the furnace.

Depth under the top	I. 5 feet.	II. 8.	III. 11.	IV. 14.	V. 17.	VI. 20.	VII. 23.	VIII. 24.	IX. 34.
Nitrogen	55·35	54·77	52·57	50·95	55·49	60·46	58·28	56·75	58·05
Carbonic acid	7·77	9·42	9·41	9·10	12·43	10·83	8·19	10·08	0·00
Carbonic oxide	25·97	20·24	23·16	19·32	18·77	19·43	29·97	25·19	37·43
Light carburetted hydrogen	3·75	8·23	4·57	6·64	4·31	4·40	1·64	2·33	0·00
Hydrogen	6·73	6·49	9·33	12·42	7·62	4·83	4·92	5·63	3·18
Olefiant gas	0·43	0·85	0·95	1·57	1·38	0·00	0·00	0·00	0·00
Cyanogen	0·00	0·00	0·00	0·00	0·00	0·00	trace.	trace.	1·34

A glance at the tabulated results shows that light carburetted hydrogen must be considered an essential constituent of the gaseous mixture, even at a depth of twenty-four feet in the furnace. Now, as one of us has elsewhere shown that carburetted hydrogen can neither be formed by the direct combination of carbon with hydrogen, nor by the decomposition of water at the expense of the coals, it must be viewed as a product of distillation, a fact of considerable importance in the theory of the process of smelting in this country, and which leads to the following conclusion,—That the region of the furnace in which the coking of the coal is effected extends to a depth of twenty-four feet from the mouth.

When we consider that the coals are thrown into the furnace in large masses, sometimes 20 lbs. in weight, it will scarcely excite surprise that the space required by the coal, before being converted entirely into coke, is above one-half of the whole depth of the furnace.

The tabulated composition of the gases further shows that the quantity of nitrogen in the gaseous mixture, taken as a depth of fourteen feet, is at a minimum, while the olefiant gas, carburetted hydrogen, and hydrogen, is at a maximum. As the latter gases are formed from coal only under the influence of an elevated temperature, we draw from this circumstance the conclusion, that the process of distillation of the coal reaches its maximum at a depth of fourteen feet. We remarked, in describing the experiments in detail, that the gases were free from the vapors of tar to a depth of fourteen feet, but that they became richly laden with them on attaining a depth of seventeen feet. The absence of these vapors from the upper part of the furnace proves that they suffer decomposition as they pass through the upper lapers of red-hot coal. The water ascending through these layers must also suffer decomposition, and this fact explains the irregularity in the proportions between the carbonic acid and carbonic oxide.

When we compare with each other the different quantities of carbonic oxide and carbonic acid at various depths of the furnace, we see a complete absence of any mutual dependence, contrary to what was observed to be the case in the smaller German furnaces fed with charcoal. In order to understand this phenomenon, it is necessary to consider attentively the conditions under which the materials are exposed.

We have already seen that the coal has to travel twenty-four feet, from the mouth to the *boshes* of the furnace, before it is deprived of its volatile carbonaceous products, hygroscopic water, and water formed by the distillation. Now, even if we admit that the temperature in this part of the furnace is never so much lowered by the uninterrupted gasification of the coal as to prevent the reduction of the iron ore, by which carbonic oxide is converted into carbonic acid, still the ore would always be exposed, not only to the deoxidizing influence of the furnace gases, but also to the oxidizing powers of the steam evolved from the coal, which has escaped being coked. The projection of the coal into the furnace in large pieces has, therefore, the effect of subjecting the ore to a simultaneous reduction and oxidation, on account of which the relation between the carbonic acid, carbonic oxide, and hydrogen, is made to depend upon local circumstances in the upper part of the furnace. Now, when we further consider that the carbonic oxide and carbonic acid escaping from the mouth of the furnace, and from the part superior to the boshes, are almost in equal proportion, we are compelled to look for the cause of reduction of the ore in a region of the furnace still deeper. However, all doubt as to this fact disappears when we refer to the proportion between the nitrogen and oxygen of the gases collected. If the reduction of the ore and evolution of carbonic acid from the limestone had been completely effected above the point of the furnace to which we reached, the gases formed below would have contained their nitrogen and oxygen in the same proportion as in air, and would not have become richer in oxygen gas. But it will be seen that this is really

not the case, by the following table of the varying proportions of oxygen and nitrogen in the gases collected from the various depths:—

Nitrogen .	79·2	79·2	79·2	79·2	79·2	79·2	79·2	79·2	79·2
Oxygen .	24·9	23·6	24·6	19·5	25·7	23·7	28·2	27·7	27·8

We see, from this series of numbers, that the relation of the gases, as regards their proportions from the mouth of the furnace downwards, is quite the reverse of that observed in the German furnaces. At first sight the circumstance strikes us as very inexplicable, because we do not know any chemical process in the furnace capable of diminishing the amount of oxygen contained in the gases; but we are enabled to explain this anomaly on an attentive consideration. The diminution of oxygen begins chiefly at the point where the gases generated by the combustion of coal become developed. The proportion of these gases to each other shows that, when liberated from the coal, they cannot mix quite uniformly with the column of air ascending from the lower parts of the furnace. Hence the gas collected at this region of the furnace is richer in the gaseous products of distillation of coal than would correspond to its average composition; the hydrogen, for example, actually increases to above 12 per cent. If we suppose, as we have done in the above numerical series, that the hydrogen is derived from the decomposition of water at the expense of the carbon, the quantity of oxygen could not decrease, whatever may be the proportion of the gases generated in this way at the various points of the furnace. But if, as we must suppose, the hydrogen is principally derived from the olefiant gas and empyreumatic oils decomposed by the high temperature, the calculation leads us to a smaller quantity of oxygen than really represents the truth. This fact warrants the conclusion,—That the mean composition of the gases *cannot* be determined at that point of the furnace where the evolution of gas by distillation is at its maximum.

The source of this uncertainty disappears in the deeper parts of the furnace, where the olefiant gas and the higher hydrocarbons are no longer present. The result obtained at the depth of twenty-three and twenty-four feet, giving the constant mean proportion 79·2 : 27, proves that under the twenty-four feet, there is an evolution of carbonic acid caused either by the reduction of the ore, or by the escape of carbonic acid from the limestone, or perhaps by both these causes together. Now we conclude, from the average composition of the gases evolved from the materials used in the furnace, that this evolution of carbonic acid is really owing to the reduction of the ore, and that the process of reduction takes place only in the boshes. The average composition must be somewhere between the following numbers:—

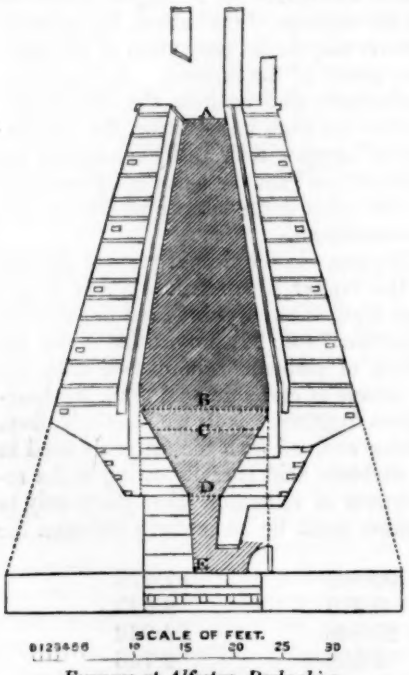
Nitrogen - - -	60·907	57·878
Carbonic acid - -	8·370	9·823
Carbonic oxide - -	26·846	24·042
Light carburetted hydrogen	2·536	2·743
Hydrogen - - -	1·126	4·972
Olefiant gas - - -	0·112	0·392
Sulphuretted hydrogen	0·045	0·035
Ammonia - - -	0·058 = 100·000	0·115 = 100·000

This mixture of gases contains,—

1. The products of distillation of the coal.
2. The products of its combustion.
3. The carbonic acid generated during the reduction of the ore, and expelled from the limestone.

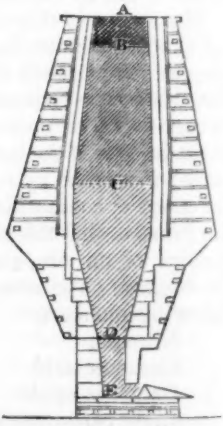
The proportion of nitrogen to oxygen, as deduced from these analyses, is 79·2 : 27·33, and 79·2 : 26·67, or an average of 79·2 : 27. The products of combustion of the coal give the proportion existing in atmospheric air 79·2 : 20·8. Now as the amount of oxygen in the products of distillation of the coal is quite insignificant, and may be safely neglected in the calculation, the increase of oxygen from 20·8 to 27 must depend upon the carbonic acid of the limestone, and the oxygen of the ore given to carbon during the reduction. But the gas collected at twenty-three and twenty-four feet deep, contains 27·6 and 26·5 oxygen to 79·2 nitrogen. Hence at this depth the gas must have already accumulated all the oxygen of the iron, and the carbonic acid of the limestone. These facts warrant us in drawing the following conclusion,—That in hot-blast furnaces fed with coal, the reduction of the iron and expulsion of carbonic acid from the limestone takes place in the boshes of the furnace.

Fig. 6.



Furnace at Alfreton, Derbyshire.

Fig. 8.



Furnace at Barum, Norway.

We cannot define by direct observation the exact region of the furnace in which the melting of the iron and formation of the slag are effected, but as the large masses of ironstone cannot enter the hearth in any form except

as a liquid, we may safely assume that the point of fusion is at the top of the hearth in hot-blast furnaces.

With the object of rendering these processes more intelligible, we have shaded a section of the furnace so as to represent the different parts employed in their special functions, the drawing being made to an exact scale. A B is the space in which the distillation proceeds, B C and C D show the region in which the reduction of the ore and evolution of the carbonic acid are effected, and in which the materials attain the temperature necessary for fusion.

The marked difference between the results obtained in the continental furnaces and those in this country will cease to excite surprise, when we bear in mind the different nature of the fuel employed. The principal reason of the great depression of the region of reduction in the furnaces of this country, is that almost all the body of the furnace is taken up in the process of coking; and hence the point of reduction must be still further lowered if the pieces of coal be of a large size. These pieces, often in bulk equal to a cubic foot, must remain a long time before the heat penetrates thoroughly through them, and the column of air ascending through this material must yield its heat in order to render gaseous above 30 per cent. of the fuel. Hence the depression of the temperature of the upper half of the furnace becomes so great that it does not suffice for the reduction of the ore, nor is it sufficient for the expulsion of carbonic acid from the limestone. Another important cause lowering the region of reduction, is the high pressure at which the blast is thrown into the furnace, the pressure being six or seven times the amount of that used in Germany. The materials, on this account, traverse through the furnace much more speedily, and therefore require to pass through a larger space to become heated.—All these circumstances have much less influence in the German and Swedish furnaces. The charcoal with which the latter are fed is a fuel almost completely coked, and the materials, being in small fragments and thoroughly mixed, offer a heating surface at least a hundred times greater than that exposed in English furnaces. The small pressure of the blast also effects a slow combustion, so that the fuel frequently takes twice or three times the period to pass through the same region of the furnace.

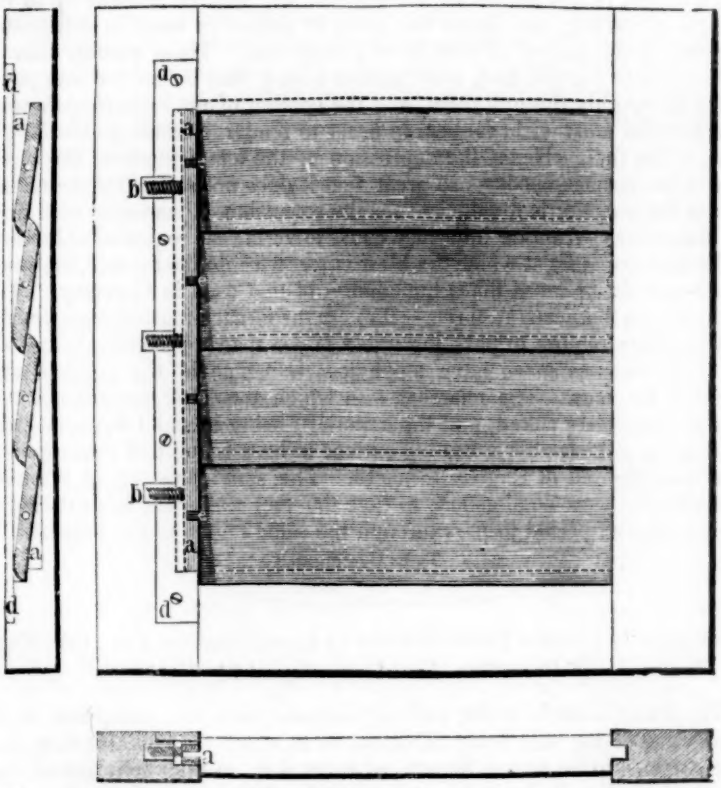
To be Continued.

Description of Venitian Blinds Patented by John Hampson, Esq., *Civ. Eng., of Carrollton, Louisiana, August* 21, 1841.

The frame is made in the ordinary manner, with the exception of the inner edge of one side being rabbited, so as to allow a movable strip, *a a*, (see sketch,) to be placed therein, of about $\frac{3}{8}$ in. in thickness, and of such width as to allow holes to be made in it, for the pivots or journals, *e e*, of one end of the slats to work in. In the edge of the frame at the bottom of the rabbit, holes are bored, in which brass wire spiral springs, India rubber, or other elastic material, are placed, as shown at *b b;* these springs keep the strip *a a* close up to the end or shoulders of the slats, with just sufficient pressure to retain them in any position in which they may be placed, and prevent them from rattling or shaking down when they are

used in railroad cars or carriages. To keep the strip *a a* in its place, and to hide the springs, a flat strip, (of the same kind of wood as the frame is made of,) *d d*, is let in and fastened with screws, as shown. This flat strip need not be over $\frac{1}{8}$ in. thick; it may be stronger if required. It is evident that, if the pivots be somewhat smaller than the holes in which they work, the weather cannot affect the movement of the slats; it is also evident that the frame may be fastened together before the slats are put in, which is not the case with the common blind, and which give great facility in repairs in case of accident.

The patentee claims the method of preventing the slats from rattling, and retaining them in any position in which they may be placed, by means of the movable strip or strips pressed up by springs or other elastic substance.



The patentee says:—"This blind has been in use in railroad cars, in and about New Orleans, for over seven years, and has given universal satisfaction. In simplicity, comfort, durability, and economy, it is all that can be desired. It is applicable wherever movable or rolling slat Venitian blinds can be used. Rolling slat Venitian shutters are desirable in many situations, and there is little doubt but that many more would be used were they (as commonly made) less troublesome and unmanageable. All

the objections that are made to the common rolling slat Venitian shutter, are removed by this improvement. The extra expense on each car blind does not exceed 20 cents, and on house blinds it would not exceed 80 cents for a window—a mere trifle in comparison with the comfort and durability."

For the privilege of using this improvement, apply to JOHN HAMPSON, Engineer and Superintendent of the New Orleans and Carrollton Railroad.

To the Committee on Publications.

Account of the Explosion of the Steam Tow Boat Defiance.

NEW ORLEANS, JUNE 10th, 1849.

GENTLEMEN,—Agreeably to your request, I forward the best information I could obtain after the receipt of your letter; at the time of the explosion, my engagements prevented me from investigating this matter, although anxious to do so.

The Defiance (belonging to the Independent Tow Boat Company) is a new boat, her engines and boilers were built by Messrs Shield & Co., Cincinnati. The boilers I suppose were made from drawings furnished by Mr. Montgomery, (who claims the plan,*) as they are similar to a pair made here for him, which were tried and condemned; I mention this as these have the same weakness, which in my opinion was the cause of the Defiance's giving way.

Coming down the river the boilers performed well, indeed they could not do otherwise, for in addition to being new, there is a large amount of fire surface; it is said that the boilers foamed much; this is reasonable, for the water is greatly subdivided.†

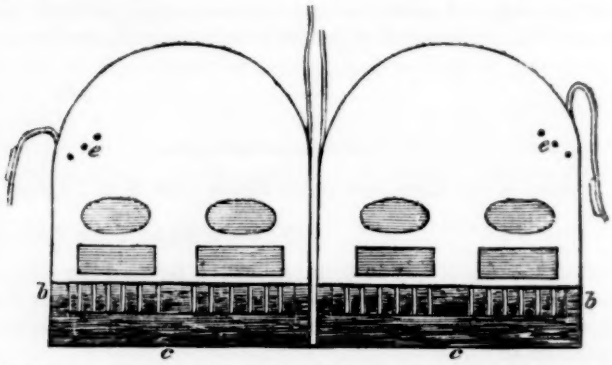
The external appearance of the boilers before injury, was similar to many of the so called low pressure ones. Internally, the fire acts on two arched crowns or flues, the flame passing back over a water bridge pipe (the end as shown by the dotted lines) to a chamber, *a*, and there it is diffused and circulates around 600 vertical tubes, ($1\frac{3}{4}$ inches in the clear,) before it enters the chimney; the lower ends of these tubes (a few are seen at *b*) are connected with a sheet forming the top part of a water bottom, *c;* the upper ends of the tubes are secured to a "table" or head sheet as shown in the sketch; these tubes, along with the water sides or spaces, ($3\frac{1}{2}$ inches in the clear,) forming a free communication for the circulation of the water. The attachment for the supply pipe is at *d*. The lowest of the

* I have in my possession a sketch, taken from a boiler, made by Mr. Holloway of your city, and put in the Thomas Jefferson, a low pressure boat, at Norfolk, Va., in 1833. The only difference is that in this boiler (Holloway's) the vertical water pipes are of larger diameter, and fewer in number, advantages that practice will lead to in this, otherwise its action was exactly similar to this patent one.

† The boilers having none but the ordinary gauge cocks, it would be very difficult to know the exact height of the water when foaming. In 1833, I had an English locomotive in my charge, which would show water at the upper cock, when there was not twenty gallons of water in the boiler; (I then devised the plan of gauge chamber, see *p.* 94, *vol.* XXI, 2d *series*, I think a republication of this would do good, as I and others have used it often since, and find it to be all that is desired; see also July number, 1841, page 14.)

gauge cocks, *e*, are 2½ inches above the table or head sheet, the middle ones 2½ inches higher, and the top cocks 2½ inches above the middle ones.

The boilers were not displaced by the explosion, and, as will be seen by the diagram, they present nearly the same appearance as when viewed end on.

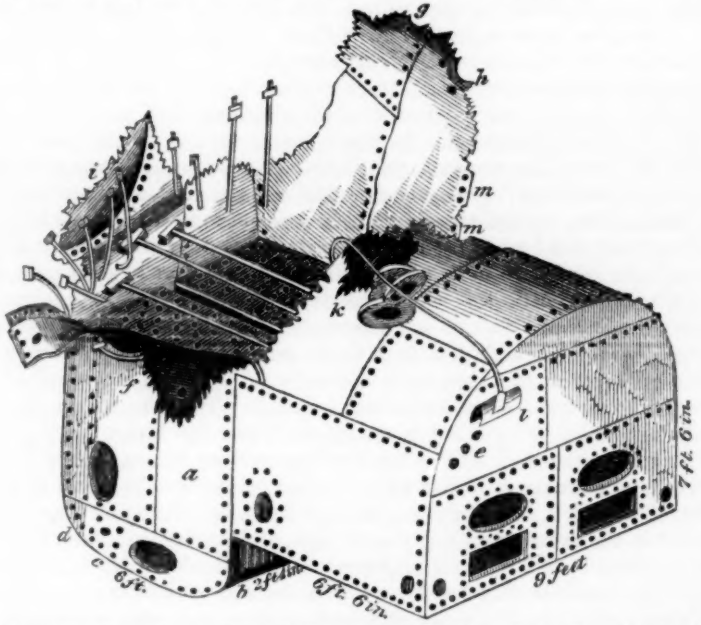


The Defiance started on the 24th of March, at 11 o'clock at night, with her first tow, having one ship on each side, and another astern; they ran slow through the night, on account of fog, but had increased her speed when it became clear, not long after the watch was changed, at 8 A. M.; the chief engineer (who is said to have been a very careful man) coming on duty, had tried the gauge cocks, and found the water "fair,"* and was in the act of passing from the boilers when they bursted, and he was thrown against a brace which caused an internal injury, of which he died a few hours afterwards. I suppose that the starboard boiler, (which is the one sketched,) gave away first, followed almost instantaneously by the other; the report was of a "dull sound." The force and direction of the bursting was upwards, and towards the starboard side, as part of the top of the starboard boiler, with the steam drum, etc., passed over the ship on that side; the boat having headway at the time, part of the fragments which ascended vertically, fell on the deck of the stern tow; much water in nearly a cold state fell on the deck of the Defiance. As a matter of course, all that was above the boilers, including the man at the steering wheel, were carried away; this is the seventh time of this steersman being tossed in the air, under similar circumstances, with scarcely any injury.

In this case, along with many others, an *explosive gas* has been lugged in to account for the bursting; never having been a believer in this theory, I will give something more tangible to account for the bursting. The semi-cylindrical shell being 9 feet in diameter, and only ¼ of an inch in thickness, without stays or other adjuncts, is at once seen to be too light for a working pressure ranging from 100 to 150 lbs. to the square inch; now to this first want of strength, an *unnecessarily* large hole (22 × 14 in.) is made for the man head rim, (a fragment is seen at *f*,) and another for the steam drum *g;* and to weaken the shell still more, yet another hole was cut for the safety valve (at *h*,) which would have been better on the top of the

* He may have been deceived, but the want of strength of the shell, was sufficient cause in itself.

steam drum; all the holes being enclosed within the space of a few feet, it requires no fancy to suppose that the starting point of rupture was at the man hole, taking the other two holes in its course; when once ruptured, then running down the line of rivets and straightening out the sheets, as is common in explosions of this form of boiler. Part of the top of the back of the shell, like a hood, is thrown over, as is seen at *i;* a small piece of the shell of an irregular form, with the safety valve (which is of ample size) attached to it, is bent over towards the front, as seen at *k;* the blow from the casting has caused an indentation on the top of the shell. Along side of it is seen part of one of the fore and aft stays ($1\frac{1}{4}$ in. in diam.) the plate part at *l*, having been torn from the back end of the boiler.



Along the lap edges of the shell, much of the iron is broken short, while a small part has the appearance of being torn; some of the match holes in each sheet, as at *m m*, are perfect, the rivets giving way without injury to the sheet. All the internal parts, with the sides, ends, and top part of the shell immediately over the arches, *(which are well stayed,)* remain uninjured.

I am not one of the advocates for making boiler plates very thick, believing that their imperfections keep pace with the thickness, but prudence and experience should have prevented the using as light iron as this.

It is not a usual practice to use stays for the shell of a boiler, as they are objectional; but I think that when the boilers are of this form, and of large size, using high steam, that ribs of angle iron passing over the top, down to each side and riveted to the sheet, would be beneficial, as, if the boiler did give way, it would prevent the large opening always made, and reduce some of the destruction consequent to an explosion.

Respectfully yours, A. C. Jones.

Mode of Extinguishing Fires in Coal Mines.

For the following interesting account of the successful result of an experiment made to extinguish a fire in the coal mine of Mr. Darlington, at Astley Collieries, near Manchester, we are indebted to the *Times*. Mr. Darlington, who is the author of the communication, writes as follows:—

"On Monday, the 2nd of April, one of my coal mines, at Astley, was discovered to be on fire, and had spread to such an alarming extent as to prevent all access by the usual shafts. We immediately put out all the fires about the works, and requested the cottagers in the neighborhood to do the same, for fear of an explosion. The plan of procedure in such cases (which happen more frequently than those unacquainted with collieries suppose) is, first to stop down all openings into the mine, so as to prevent any access of the atmosphere. If, after some time, the fire is found not extinguished, the only alternative is to fill the mine with water from some source in the neighborhood. In the absence of a sufficient reservoir of water, the pumps are stopped, and the water allowed to accumulate from the natural drainings, generally an unsatisfactory and slow process. In the former plan, notwithstanding every precaution is taken in sealing the shafts, it is found by experience that air in small quantities will oe drawn through the stoppings and fissures of the earth sufficient to keep up a slow rate of combustion for a very long period. We have proof of this in many instances occurring in this neighborhood. In the extensive collieries worked by Lord Bradford, at Bolton, the mine has been on fire nearly two years. When the fire happened, it was sealed up for some months; but, on opening it, the fire was found still burning. The pits were again immediately sealed up, and left to remain for twice the former period. On opening the mine at this time the fire burst out as before. It was again closed, and so remains to this day. At the collieries of the Earl of Ellesmere, at Worsley, one of the mines took fire about the same time; it was treated in the same way; it is still on fire; and, at this moment, his lordship is about to turn in the Bridgewater Canal. In the Patricroft Colliery, the deepest mine in this county, a fire broke out in the upper part of the workings, which baffled every attempt to extinguish it, and is now stopped up and abandoned. At Mr. Blundell's colliery, at Blackrod, in this district, the pits were opened after being closed some weeks, on account of fire, when a fearful explosion took place, and did considerable mischief to the workings. The fire burned with greater intensity than ever: the flames rose out of the mines, set fire to the head-gear, and burned so fiercely within the pit that it actually melted the iron tram-wheels. In this case the River Douglas was eventually turned into the workings so as to fill them with water. I could mention several other cases in this immediate neighborhood, to show the importance of the question before us, and the difficulties we have to contend with when these unfortunate accidents occur. In our case we instantly sealed up the mine, yet fire-damp issued from every crevice about the stoppings, and through orifices in the earth, in such quantities that the safety lamps would take fire at a considerable distance. In this state of things I wrote to Mr. Goldsworthy Gurney, (whose application of high-pressure steam to the ventilation of coal mines

is exciting so much interest,) stating the case, and asking if he could point out any plan, by high-pressure steam exhaustion, or otherwise, likely to be of service. Mr. Gurney immediately came down, and after well investigating the conditions, in consultation with us, proposed to fill the mine with carbonic acid, azote, or some other extinguishing and incombustable gas. This, at first, appeared to us impracticable,—the immense quantity required to fill the galleries and lateral workings, together above three miles in length, being too expensive, if it were possible to obtain it, to warrant the proposition. He, however, soon set us right. He said nitrogen, or azote, might be obtained from the winds of Heaven, and carbonic acid from the coals lying waste about the pit, assisted by a little charcoal and lime; air would be deprived of its oxygen by being passed through burning charcoal, coal, coke, and small coal, and the azote set free. In short, the product of this combustion would be the choke, or black damp known in mines. We immediately built a furnace of brickwork four feet square, at a safe distance from the downcast shaft. To the ashpit, in every other respect made tight, an iron cylinder thirteen inches in diameter was connected, and made to terminate at an elbow under water in a close tank partly filled. With the upper part of this tank, above water, another pipe was connected and carried through the stopping of the downcast pit. A powerful steam jet was made to work between the furnace and the tank, which drew the air down through the fire, and forced it through the water. A second jet was placed in the cylinder at the top of the down cast shaft, and made to draw the choke-damp from the tank, and force it into the pit. At the other, or upcast shaft, we placed a jet in a cylinder, communicating, through the stopping, with the mine, for the purpose of exhausting the shaft beneath and thereby assisting the compressing jets to drive the choke-damp through the galleries. The apparatus thus fitted, as soon as the fire in the furnace had burned up, was set in action. In order to test the effect of the choke-damp, we placed some burning tow, moistened with spirits of turpentine, into it. The flame was as instantly extinguished as if it had been placed in water. It was thus tested in the cylinder, as it passed from the ash-pit, before coming to the jet, and also in the tank and second cylinder, with similar results. This was conclusive evidence of the perfect formation of the choke-damp. In about two hours after the jets were set in action, fire-damp disappeared from the shafts, and we observed a slight cloudy appearance in the escapage from the upcast shaft. It had the sulphurous smell of choke-damp, which pervaded the air to a considerable distance. A safety lamp was now brought and placed in the upcast cylinder; it became instantly extinguished as if put into water. For this purpose the draughts were momentarily shut off. A bright burning fire of charcoal, in a chafing dish, was placed in the escapage at the cylinder, and was also immediately extinguished. These facts satisfied us that the choke-damp had passed through the mine. The period of its appearance agreed with our calculations. The quantity of choke-damp forced through the mine was about 6000 cubic feet per minute, and this would fill the galleries in about that time. The choke-damp was allowed to remain for several hours, at the termination of which we were convinced that all fire, however intense, must be extinguished in the mine. The connexion with the furnace was

now broken, and fresh air driven through by the same jets. In about two hours the choke-damp disappeared; this was shown by a safety lamp burning clearly in the escapage in the cylinder at the upcast shaft. We regarded the mine now as perfectly safe. With several men I descended the downcast shaft, 390 feet deep, to the tunnel leading to the working. We found all clear: the exhausting jet was kept up, drawing fresh air through the mine all night. The next day several men went down, and passed through the workings, and found all clear and safe. Their report was particularly favorable. In no part of the mine could they perceive any fire, and the action of the single jet in the upcast is described by them as passing a current with greater speed than the furnace (which is pronounced to be the most effectual one in the county) had ever before done in this or any other of the mines of which I am the proprietor. This result has occasioned the greatest interest in our neighborhood. Never was an experiment more successful. A gigantic power under such complete control, fighting with the elements, and, as it were, compelling them to destroy each other. The application of high-pressure steam to the ventilation of coal mines may effect a greater protection to life and property, but we regard this application as little inferior to the coal trade, and a triumph of science equal to any of the present day. Lon. Jour. Arts. June, 1849.

Translated for the Journal of the Franklin Institute.

Electricity of the Human Frame.

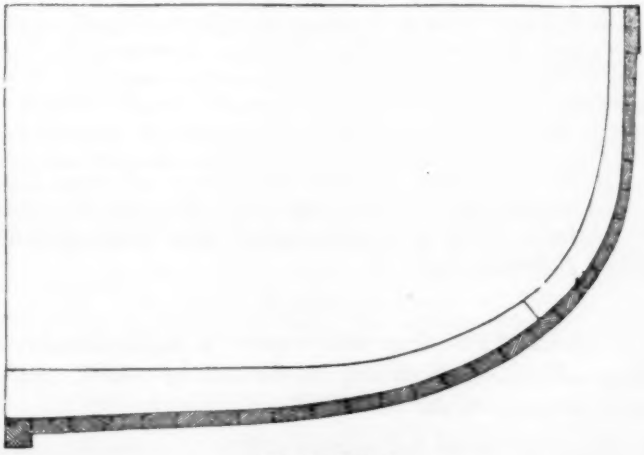
At a meeting of the Academy of Sciences of Paris, 21st May, 1849, M. de Humboldt sent an extract of a letter in which M. Emile du Boys-Reymond describes summarily an experiment which consists in causing the deviation of the needle of a galvanometer, by the effect of muscular action. The following passages are from this letter:—"I take a very sensitive galvanometer; I fix at its two extremities, two slips of perfectly homogeneous platina; I plunge these two slips into two vessels filled with salt water, and I then introduce into these same vessels two corresponding fingers of my two hands. At the first immersion of the fingers a more or less decided deviation of the needle is always produced, the direction of which follows no law, and which is probably due at least in part to some heterogeneousness of the skin of the fingers. When there is a wound on one of the fingers, the deviation is stronger, and always directed in such a way as to shew that the wounded finger behaves as the zinc of a zinc-copper couple, supposed to be between the vessels in place of the body. Of course this is not the kind of action which we are concerned with now; on the contrary, in order to observe the effects announced, we must wait, either until the needle has returned to the zero of the scale, or until it has taken a steady position under the control of the remainder of a current which cannot be overcome. When this moment has come, I strain all the muscles of one of my arms so as to establish an equilibrium between the flexors and extensors of all the joints of the arm. At once the needle moves, and the direction of the movement is such as to indicate in the stiffened arm an inverse current, according to the notation of Nobili, that is a current directed from the hand to the shoulder. This arm behaves therefore as would

the copper of the zinc-copper couple before alluded to. When I make the experiment with my galvanometer the deviation amounts to 30°. I can however obtain much more extensive movements of the needle, by contracting the muscles of the two arms, alternatively in time, with the oscillations of the needle. The amount of the deviation, all other things being equal, depends much upon the degree of development and exercise of the muscles."

M. de Humboldt adds, in a letter addressed to M. Arago, dated 17th May:—"The experiment, the effect of the human will, alternately stiffening the muscles of the two arms, leaves not the shadow of a doubt. Despite my great age, and the little force I have in my arms, the deviations of the needle were very strong. They were naturally still stronger, with M. Jean Muller, our great anatomist, and with M. Helmkoltz, author of some important physiological books, who accompanied me the day before yesterday to visit M. Emile du Boys. The experiment may be facilitated by immersing the index finger of each hand in the water, and supporting the palms of the hands so as to stiffen well the muscles of the arm which is to act." L' Institut. 23rd May, 1849.

Particulars of the Steamboat Joseph Belknap, recently built in New York, and running on the Hudson River from New York to West Point.

Length on deck, 187 feet; breadth outside of plank, 27 feet 4 inches; depth of hold, 8 feet; draft of water, 4 feet; plank of yellow pine, 2½ in. thick; floor timbers 13 in. deep, 4½ in. thick, and 28 in. from centre to centre. The dead flat, or midship section of the hull, is equidistant from stem and stern post, but the centre of gravity of the hull is 17 inches aft the midship section, caused by an overhanging transom stern.



Midship Section.

Diameter of cylinder, 3 ft. 4 in.; length of stroke, 12 ft.; diameter of water wheel, 28 ft. 10 in.; face of paddles, 8 ft.; number of paddles in each wheel, 28; depth of paddles, 2 ft. 2 in.; the paddles dip under 4 in.; ave-

rage number of revolutions, 24 per minute; average pressure of steam, 45 lbs., using Stevens' cut-off, and admitting steam 6 ft. 6 in. of the stroke. Best speed, 20 miles per hour. She has two boilers, 28 feet long, 6 feet 6 inches diameter of shell, and fronts of the same width; two furnaces in each boiler, 34 inches wide and 7 feet long, with rising flues and single return; a steam chimney on each boiler, 32 inches inside diameter, 8 feet 6 inches high, with a steam space of 8 inches outside. The consumption of anthracite coal is 2000 lbs. per hour; the boilers are supplied with air for combustion from two blowers, 54 inches in diameter, and 24 inches wide, which discharge into an air-tight fire room, and from thence to the ash pit, and are capable of making 70 lbs. of steam for 10 hours, the engine cutting off at 6½ feet.

This boat may be considered a superior specimen of work, whether we examine the machinery or the hull. The former was built by Messrs. H. R. Dunham & Co., of the Archimedes Works, in New York, and the boat is named after their engineer, Mr. Belknap. The hull was built by Colyer, the same that built the "America;" his models are well known for speed.

B.

Translated for the Journal of the Franklin Institute.

On the Method by which the Phosphate and Carbonate of Lime is introduced into the Organs of Plants.

M. J. L. Lassaigne, at the meeting of the Academy of Sciences of Paris, of the 15th January, presented a memoir upon this subject, showing by experiments that the phosphate and carbonate of lime are introduced into plants in solution in water containing carbonic acid, which had before been shown as to the phosphate by M. Dumas, and has long been known as to the carbonate.

—

We note this memoir for the purpose of saying that the first person, to our knowledge, who endeavored to call public attention to the important agency of carbonic acid dissolved in water in procuring food for plants, from otherwise insoluble salts, was the late Mr. Charles Roberts, of this city, who in the year 1839, suggested the experiments made in the laboratory of Prof. Booth, in which it was shown that the green sand of New Jersey (silicate of potassa and protoxide of iron) was thus dissolved. Oxalic acid was also shown to be an excellent solvent for this usually refractory substance, which rarely yields entirely even to nitro-muriatic acid, except by a prolonged digestion.

F.

On the Explosion of Fire-damp which occurred in the Eaglesbush or Eskyn Colliery, Neath, South Wales, on the 29th of March, 1848. *By* Joshua Richardson. *M. Inst. C. E.*

This paper first detailed the frequency of these occurrences in some parts of South Wales, and more particularly in this colliery, where the tender and friable nature of the coal peculiarly induced in the working, or excavation, the formation of fire-damp and explosive gas. This had been shown

experimentally, by Sir Humphrey Davy, when, on breaking up large coal under water, he collected a quantity of fire-damp at the surface.

It then gave a description of the colliery workings; the state of the mine before the explosion occurred; the condition in which it was found at the time of the inspection—a fortnight after the accident; the probable causes of the catastrophe, and the best known means of preventing a recurrence of such events.

The seam of coal was described as being about four feet in thickness, of a highly bituminous and friable nature, and worked by an inclined adit, or entrance, with a main gallery, whence the stalls were worked on either side—horses being employed to draw out the coal in trams, which were conveyed direct to the vessels in which it was shipped for exportation to the extent of thirty thousand tons annually. The ventilation was effected by a down-cast and an up-cast shaft, between which an air course was arranged so as to extend throughout the active workings, with a chimney at the exit, through which the air should have been expedited by a furnace, which, however, had been rarely lighted; and the air course, which was one mile and five furlongs in length, was in places of unequal and inadequate areas, so that, in certain states of external atmosphere, the air in the mine became very sluggish, and even at times oscillated to and fro instead of regularly traveling onwards in an uninterrupted current. This was so much the case, that the colliers employed fans to drive the gas from them into the proper channels. Great negligence appeared to have existed, both in the general system of working, and in the use of the Davy lamps, which were frequently used without the wire gauze guards.

The usual state of the mine could not be judged of by an inspection *after* an accident, as all the falls and incumbrances had been removed, the destroyed door and stoppings had been well replaced, and general precautions had been adopted, which evidently had not previously existed; but there still remained evidences of want of precautionary measures. Candles and open lamps had been constantly used, although the general fiery character of the mine was notorious; and, after the explosion, two Davy lamps were found without their wire gauze guards.

The temperature in various parts of the mine was so near that of the external atmosphere, that it was evident spontaneous ventilation could not have proceeded regularly; and it was shown that the slightest change of the density of the air, even from the sun breaking out, would have sufficed to render stagnant the whole system of ventilation; especially as the furnace, which should have accelerated the current by exhaustion, had been allowed to fall into a ruinous condition, and had seldom been used, and the velocity of the current had rarely exceeded five feet per second, which was totally inadequate to supply the requisite quantity of air for such an extent of workings.

The cause of the accident was therefore very apparent, and might be attributed to a want of general good system of ventilation, permitting accumulations of gas and fire-damp, and the careless use of open lights, or unserviceable Davy lamps; and the consequence of this was the sudden death of twenty men, and several horses, with great injury to the mine.

The means of prevention were, evidently, a complete revision of the system of ventilation—the enlarging of the air course to uniform and ade-

quate dimensions—the proper division of the air into several columns—the construction of proper doors and stoppings in convenient positions—strict regulations for the use of Davy lamps, or other means of lighting, and better general superintendence, by educated men, who would enforce precautionary measures.

Due credit was given to the proprietors for their anxiety to afford every means of inspection, and for adopting all suggestions calculated to prevent the recurrence of such an event; and it was stated that they had since erected one of Mr. Price Struve's ventilating apparatus, of the working of which an account was promised in a future communication.

In the discussion which ensued, the various systems of working and of ventilation, in all parts of England, were noticed; and it was shown that, in general, every means was adopted to prevent accidents; but that up to the present time, the mines in the West were not as well managed as those in the North, or the midland district. Every day, however, introduced better measures and better men, of education, for carrying into effect the most approved systems, and that, as the mines became more extensively worked, so these accidents would and did become less frequent. —*Proc. Insti. Civ. Engineers.* Prac. Mech. Jour. April, 1849.

Translated for the Journal of the Franklin Institute.

Use of Colored Glasses to Assist the View in Fogs.

The following curious observation is made by M. Luvini, of Turin, in a letter to the editor of *L'Institut*, at Paris. If it be verified, it may prove to be of importance to geodetical operations, as well as in observations at sea.

"When there is a fog between two corresponding stations, so that the one station can with difficulty be seen from the other, if the observer passes a colored glass between his eye and the eye-piece of his telescope, the effect of the fog is very sensibly diminished, so that frequently the signals from the other station can be very plainly perceived, when, without the colored glass, the station itself could not be seen. The different colors do not all produce this effect in the same degree. The red seems the most proper for the experiment. Those who have good sight prefer the dark red, those who are short-sighted like light red better. The explanation of this effect seem to depend upon the fact that the white color of the fog strikes too powerfully upon the organ of sight, especially if the glass have a somewhat large field. On the contrary, by placing a colored glass between the eye of the observer and the eye-glass of the instrument, the intensity of the light is much diminished by the interception of a part of the rays; the observer's eye is less wearied, suffers less, and consequently distinguishes better the outlines of the object observed."

L'Institut, Jan. 4, 1849.

New Material for Printing Types.

On Saturday last, (May 26,) a new invention, which is called the apyrotype machine, was submitted for inspection at a meeting of the Royal

Society, and elicited the highest approbation of many of the most eminent members of that body; it is also now in course of private exhibition in Bartlett's buildings, Holborn, with a view of bringing it under the notice of practical men, in order to promote its introduction into actual operation. The object of this invention is, by means of self-acting machinery, to manufacture printing type not liable to the fragility, softness, and rapid deterioration—the much-complained of defects of the type at present in use.—These defects arise from the use of an alloy fusible at a low temperature; the metal possessed of that property being destitute of the degree of hardness requisite for producing those numberless impressions of the "broad sheet" which have now become one of the prime wants of modern civilization. This desideratum is secured by the use of hard metals—such as zinc, copper, and even iron; and, instead of fusing the metal, and pouring it into moulds, to give it the required form, the type is manufactured by a mechanical operation at ordinary temperatures, chiefly by means of powerful pressure and the use of steel dies. The exact durability of the article thus manufactured has yet to be ascertained by experiment; but the superiority of copper, even in its ordinary and uncompressed state, is estimated by practical persons to exceed the material now commonly used in the proportion of 100 to 1. This invention, the credit of which is due to a Frenchman, named M. Petit, who has labored unremittingly for the last seven years to bring it to its present degree of maturity, is regarded by many as destined ultimately to constitute quite a new era in the art of typography.

Lond. Min. Journ., June, 1849.

Account of a Binocular Camera, and of a Method of obtaining Drawings of Full Length or Colossal Statues, and of Living Bodies, which can be Exhibited as solids by the Stereoscope. By Sir David Brewster, F. R. S.

In this paper the author pointed out the changes which take place in the visual representation of bodies of three dimensions, such as statues, buildings, and living bodies, when they are viewed at different distances by one or both eyes, or when reduced copies of statues are viewed in a similar manner. He showed that full length and colossal statues, as works of art, are not so perfectly seen as reduced copies of them, and that there is *cæteris paribus* a certain ratio between the distance of the eyes and the magnitude of a body of three dimensions, when its visual form is best developed. The author then described a Binocular Camera, and explained a method of obtaining by its means such dissimilar drawings on a plane of full length, and colossal statues and living bodies, as will give the best representations of them in relief when united by the stereoscope. The Binocular Camera described by the author is composed of two semi-lenses, obtained by bisecting an achromatic lens. These semi-lenses are placed at the distance of the two eyes, or at such multiples of that distance as may be necessary to take dissimilar drawings of full-sized or colossal statues, for the purpose of reproducing the statue in the stereoscope. The author described and explained a method by which statues of all sizes, and living bodies, may be reproduced, as it were, and exhibited in three dimensions: and he pointed out the great advantage which the sculptor

would derive from the possession of dissimilar drawings of works of art, and from the study of them when viewed in their true relief in the stereoscope: A Microscopic Stereoscope, with several curious diagrams, was exhibited, and, in particular, the effect of dissimilar drawings, made by the Binocular Camera, of Danneker's statue of Ariadne on the Leopard, when united in the stereoscope. The united image stood out in high relief as in the original statue.—*Proc. Royal Scottish Soc. Arts.*

Civ. Eng. and Arch. Journ., June 1849.

Translated for the Journal of the Franklin Institute.

Method for the Carbonization of Organic Matters, for the Detection of Minute Quantities of Arsenic. By M. Filhol.

In an excellent and elaborate article upon arsenic, M. Filhol proposes the following modification of Orfila's process for carbonizing organic substances which are suspected to contain it in minute quantities. The object of this modification is to avoid the rapid ignition of the carbon which frequently takes place at the end of the operation, and by which much of the material is frequently lost. To prevent this, M. Filhol proposes the addition of a small quantity of sulphuric acid, (12 or 15 drops for 100 grammes of nitric acid,) to the nitric acid, and directs the process to be conducted as if with the pure nitric acid. The combustion of the carbon will thus be rendered impossible, as it will remain moistened with sulphuric acid, owing to the volatility of this substance, after the whole of the nitric acid has been evaporated. M. Filhol states that the results given by this process are as good as those of the more tedious method proposed by MM. Flandin and Danger. Journ. de Pharmacie et Chemie, Dec. 1848.

From the London Mechanics' Magazine for March, 1849.

Strength of Glass Pipes—Experiments by Chas. Thornton Coathupe.

In consequence of the perusal of the editorial remarks as to the probable "why or wherefore" glass pipes were not substituted for pipes of lead at Claremont, I gave directions to the chief mechanic at our works to prepare hydraulic apparatus for testing the strength of glass pipes—such as are ordinarily made at the Nailsea Glass Works.

All the pipes submitted to trial were cut to three feet in length. Their internal diameters varied from $1\frac{1}{8}$ inches to $2\frac{3}{4}$ inches. The various thicknesses ranged from $\frac{1}{11}$th to $\frac{3}{16}$ths of an inch. In every instance each pipe sustained an internal pressure of 672 lbs. per sq. inch. In two instances only did any pipe burst with a less pressure than 784 lbs. per sq. inch. In all the other trials every tube was removed, unbroken, under a pressure of 1568 lbs. per sq. inch. To you I offer the first rough statement that has yet appeared on this interesting subject. I need not inform you that a series of experiments are in progress, which, when complete, may possibly prove somewhat astounding "to engineers and others," whose duty we have hitherto considered it to be, to experiment for themselves, upon captivating novelties touching their own art.

The more minute, as well as the more extended matters of interest, must be reserved for a future communication.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, July 19th, 1849.

Thomas Fletcher, Vice President, in the chair.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations to the Library were received from—The Royal Geographical Society, London; Prof. A. D. Bache, Washington City, D. C.; Asbury Dickens, Esq., Secretary U. S. Senate; Lieut. T. A. Jenkins, U. S. Navy; Prof. M. H. Boyè, Prof. J. C. Booth, Messrs. Joseph Cresson, and M. A. Root, Philadelphia.

Donations to the Cabinet of Minerals were received from William Bakewell, Esq., of Pittsburg, Penn., and Theodore F. Moss, Esq., of Philadelphia.

The Treasurer's monthly statement of the receipts and payments was read.

The Board of Managers and Standing Committees reported their minutes.

New candidates for membership in the Institute were proposed, and those proposed at the last meeting were elected.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on the Catoptric, Dioptric, and Catadioptric Systems of Lights for Lighthouses.

Continued from page 68.

Appendix containing the Notes referred to in the Report.

NOTE 1. Communication from Messrs. E. & G. W. Blunt, of New York; 25th Congress, 2d session; documents 258 and 738.

Report from I. W. P. Lewis, Civil Engineer, upon the condition of the lighthouses, beacons, buoys, and navigation, upon the coasts of Maine, New Hampshire, and Massachusetts; 27th Congress, 3d session; document 183, H. Rep.

Extracts from a Report upon the Dioptric Light, addressed to the Secretary of the Treasury, by I. W. P. LEWIS, *Civil Engineer, April* 23, 1845.

"One of the most remarkable defects in the fitting up of our lighthouses is the diminutive size of the reflectors, which, for the most part, are only 14 inches in diameter; the burners are uniformly three-fourths of an inch in diameter. Now these same burners would illuminate a reflector of 25 inches diameter just as perfectly as they do the reflector of 14 inches diameter, and the gain of light, without any increase in the consumption of oil, would be thus:—

Taking the magnifying power of a 25-inch reflector at	327 burners,
Then, by proportion, the 14-inch reflector has a magnifying power of - - - - -	103 burners,
Loss of light by use of small reflector -	224 burners.

In other words, we lose two-thirds of the light generated in our burners, by using small reflectors instead of large ones. We may use any other figures to represent the relative power of the two sizes of reflectors above named, but the proportion will remain the same. In France, reflectors of 36 inches diameter were formerly in use, and the standard sizes adopted in Great Britain for the last 35 years has been 25 inches for revolving lights, and 21 inches for fixed lights."

"By the U. S. Catalogue of 1842, the various sizes of reflectors then in use at 242 lighthouses were—

Of 9	inches	diameter	at	-		21	stations.
14	"	"	-	-		127	"
15	"	"	-	-		46	"
16	"	"	-	-		17	"
18	"	"	-	-		2	"
21	"	"	-	-		10	"
Size not stated, but supposed to be 14 in.						19	"
						242	

"In every fixed light, the number of lamps and reflectors should correspond to the extent of horizon to be lighted. Each parabolic reflector has an effective divergence of not more than 15° in azimuth; consequently a light located on a rock in the sea, like Boon Island or Mount Desert, should have 24 reflectors, because these lights are required to illuminate a navigable horizon of 360 degrees, and because $15 \times 24 = 360$. But Boon Island has only 12 reflectors, or half the number it should have, and Mount Desert has only 10 reflectors. In the first, each reflector is expected to cover a sector of 30 degrees in azimuth, while the latter must be supposed to cover 36 degrees of azimuth by each reflector, in order to render its light visible from all parts of the horizon. This extraordinary deficiency in the proper number of lamps and reflectors is common to all the fixed lights on our coast, and there is one case where there are but 7 reflectors for the entire circle of the horizon, which implies an effective divergence of 51⅜ degrees for each reflector. The 28 exterior fixed lights in the annexed catalogue are illuminated with 276 lamps. According to the sea horizon which each of these is *supposed* to illuminate, there should be 503 lamps, allowing the effective divergence of a reflector to be 15 degrees. Mr. Alan Stevenson only allows 11 degrees of divergence, and states that, if more than this is permitted, the lights will be visibly weaker in the points intermediate between any two adjacent reflectors. At a distance of 10 miles, many of our fixed lights are hardly visible from the cause above stated, and in hazy weather it would be physically impossible for any one to see either of the two lights above named, from a point intermediate between the axes of any two reflectors, at even one-half that distance."

"It is evident, from the foregoing statement, that, in order to make our fixed lights as equally brilliant in all azimuths as they now appear only in particular directions, it will be necessary to double the number of lamps and reflectors, and consequently the consumption of oil. * * * In the Dioptric system of fixed lights, we have the very reverse of all this. The economy for each order respectively is greatest when it is required to illu-

minate the entire horizon of 360 degrees; because, to increase its range of usefulness, we do not add lamps, but only lenses."

"The following table shows the illuminating power of the combined effects of 10 parabolic reflectors of 25 inches diameter, representing one face of a revolving light of 3 faces, or 30 lamps in all. This is compared with a lens light of the 1st order revolving, and having 8 faces, each one being equal in illuminating power to 10 reflectors of 25 inches diameter. The reflecting light illuminates only 3 points of the horizon in its rotations, and consumes 1440 gallons of oil per annum, while the lens light illuminates 8 points of the horizon in its rotations, and consumes but 600 gallons of oil per annum."

"The lenses make their revolutions in 21 minutes and 20 seconds, and the reflectors in 8 minutes. The beam of light from each system, therefore, occupies equal times in passing the eye of the observer, the reflectors having 15 degrees of divergence, while the lenses have but 6 degrees of divergence. The illuminating power of each is expressed in Argand burners, and the table is quoted from the experiments of W. H. Barlow, Esq., C. E., who investigated the subject by command of the Sultan of Turkey.

Seconds of time.	Single reflector with Argand inch burner.	Ten reflectors with Argand inch burners.	French Lens. 4-wick burners.
1	0·0285	0·285	?
2	0·0617	0·617	?
3	0·1019	1·019	10·4
4	0·1501	1·501	10·4
5	0·2133	2·133	10·4
6	0·2937	2·937	10·4
7	0·4019	4·019	10·4
8	0·5555	5·555	10·4
9	0·7905	7·905	10·4
10	1·0000	10·000	10·4
11	1·0000	10·000	10·4
12	1·0000	10·000	10·4
13	1·0000	10·000	10·4
14	1·0000	10·000	10·4
15	1·0000	10·000	10·4
16	1·0000	10·000	10·4
17	0·7905	7·905	10·4
18	0·5555	5·555	?
19	0·4019	4·019	?
20	0·2937	2·937	Dark.
21	0·2133	2·133	"
22	0·1501	1·501	"
23	0·1019	1·019	"
24	0·0617	0·617	"
25	0·0285	0·285	"
26	Dark.	Dark.	"

These figures illustrate the peculiarities of the reflector and the lens. The reflector does not attain the maximum of its power until the 10th second of time in its rotations, and retains this power only for 7 seconds, while the lens reaches its maximum effect in the 3d second of time, and retains it for 15 seconds. The gradual increase for each second of time in the illuminating power of the reflector, until it reaches its maximum, the short duration of its maximum, and rapid decrease to minimum power,

prove the important fact that this instrument has not sufficient effective divergence to be used advantageously for fixed lights in comparison with dioptric lights, whose peculiar value consists in a perfectly equal distribution of light to all azimuths—an effect not attainable with reflectors."

"In the foregoing tables, the duration of the highest periods is as 14 to 6: that is to say, the number of degrees of the horizon illuminated with the brightest light, by the eight faces of a system of lenses, is to the brightest light by the three sides of a reflector frame as 14 to 6. Consequently we should require seven sides to our reflector frame, to be equal in this respect to the lenses, and as each side must have ten reflectors to be equal in power to one face of the lens system, we should require to consume the oil of 70 Argand lamps to produce the same effect with the present construction of our reflectors, as that which is obtained with lenses with the consumption of 13 Argand lamps, viz:

70 lamps at 48 gallons per year is - -	3360
13 " " " - -	624
Excess - - -	2736

Extract from the reply of Capt. W. H. Swift, *Top. Eng., to the interrogatories addressed to him on the 14th April, 1842, by the Commissioners appointed to investigate the affairs of the New York Custom House; being his answers to the first six questions.*

1. I am a captain in the corps of topographical engineers, and my present station is Springfield, Massachusetts.

2. I am somewhat familiar with the appearance of the lights in Long Island Sound. I have been in the habit of passing and re-passing them several times during the year, for 20 years past. With those on other parts of the coast I am less familiar, but have seen many of them.

3. I have noticed the appearance of a number of the lights on the western coast of England, and the eastern coast of Ireland—for example, the Holyhead, Skerries, Tuskar, Mouth of Wyre, and others in the Irish Sea. I have not noticed any of the lights upon the coast of France.

4. I have never *seen* upon our coast a light which approached, in a remote degree even, the brilliancy exhibited by the English lights, which I have referred to above. It is proper that, at the same time, I should state that I have not yet seen the lights at Neversink, fitted with the lenticular apparatus of Fresnel; nor have I seen the lights at Boston and Stonington, fitted with the English illuminating apparatus. I can perceive no reason why these three lights should not be equal in brilliancy to those of the same class in England and France.

5. The great difference in the appearance between our lights and those of England is ascribable, I conclude, entirely to the superior character of the illuminating apparatus adopted in England. In that country, reflectors of proper form and of great size (from 21 to 28 inches in diameter) are in use; while with us, as I perceive by a statement of the Fifth Auditor, of December 1, 1839, the reflectors in our lights vary from 9 to 16 inches diameter, three lights only being furnished with reflectors of 18 inches.—Not only the size but the shape of the reflector affects materially the quantity of light furnished by a given lamp, as may be readily supposed. I

cannot state from personal knowledge whether sufficient attention has been given to the shape and reflecting surface of the reflectors; but, judging from information which I have received, and from the report of the naval offices appointed to examine the lighthouses in 1838, (Document 24, H. R., December 13, 1838,) I should infer that, in this respect, this important matter had not received sufficient attention.

The French apparatus (Fresnel's) is again superior to the English. Both are immeasurably superior to our own, as all may perceive who will read the descriptions of the several systems adopted by each country.

6. The reply to question 5 furnishes an answer to the greater part of No. 6. The *principle* of the illuminating apparatus is claimed to be similar to that of the English, but the immense superiority of the lights of the latter, in point of brilliancy, would seem to disprove the statement. I repeat, that such of the English lights as I have seen far exceed in brilliancy those of our own coast, with the appearance of which I have stated myself to be familiar.

Letter from the Secretary of the Treasury of the United States, with Reports and Documents; 25th Congress, 3d session, H. R. Doc. 24.

Report of Mr. Davis; 6th Congress, 1st session, S. Doc. 474.

Report of the Secretary of the Treasury of the United States, on the Improvements in the Lighthouse System, and embracing Report from Lieut. T. A. Jenkins, U. S. N., and Lieut. R. Bache, U. S. N.; 29th Congress, 1st session, Doc. 488.

Extract from the preceding Report.

"Without referring further in this connexion, to the European lights, and the boards under which they are placed, we will proceed to remark briefly upon those of our own country, and of the manner in which they are controlled and superintended. We have visited some of the lights in the vicinity of New York, in Chesapeake bay, and at the capes of Virginia and Delaware, &c.; besides which, we have seen many of the lights on the coasts of Maine and Massachusetts, in Long Island sound, and Chesapeake bay. These visits and observations have enabled us to draw, as we believe, a fair and just comparison between the lights on our coasts and those of other countries; and we feel constrained, although with deep regret, to state that ours are far inferior to any and all we saw during our visit to Europe. This inferiority is strongly marked in the towers, buildings, lanterns and their fixtures, in the illuminating apparatus, and, in general, in the attendance upon, and supervision of, the lights. The lamps are of decidedly bad construction; the reflectors, with a single exception, of an inferior description; and both lamps and reflectors so badly attached to their frames that it would be almost impossible to keep them in perfect adjustment: as it is, very few of them *even approximate* to it.

"From the manner in which the keepers are permitted to enter upon their duties—taking charge of lights without any previous knowledge of, or instruction in, the duties of such an establishment—it is not so surprising that many of them are in bad condition, and not properly attended to."

The Documents published by Congress, relating to Lighthouses, some of which are referred to in these Reports, may also be consulted.

Note 2. Annaire pour l'an 1831, presente au Roi, par le Bureau des Longitudes; Notices Scientifiques, par M. Arago.

Stevenson's Notes on the Illumination of Lighthouses, 1848, quarto, London and Edinburgh.

Report of Select Committee of the House of Commons of Great Britain, upon Lighthouses; 1 vol. folio, London, 1845. Evidence of Alan Stevenson.

See remarks of William Herschell on the reflection of light from surfaces of *speculum* metal, in the Philosophical Transactions, Vol. 90, page 64, London.

(To be Continued.)

Report on R. E. Monaghan's Apparatus for Recording the Ayes and Nays in Legislative Assemblies.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, to whom was referred for examination—"A method of recording the Ayes and Nays in Legislative Assemblies," invented by Mr. R. E. Monaghan of West Chester, Pennsylvania.—Report:—

That the method of Mr. Monaghen consists in an arrangement of wires similar to that used in hanging our common house bells. Two such wires lead from the desk of each member to the desk of the Clerk, where each one is attached to a lever, the free end of which carries a cutting edge or point.

Upon a suitable frame under the levers are placed lists of the members of the house, as many in number as it is desired to have copies of the record; and the levers are so arranged that the points of those attached to each desk are placed, the one before, the other after the name, and the columns in which the marks from these points come, are headed, the one ayes, and the other nays.

The member votes by pulling either one or the other of the wires attached to his desk, which are labelled aye and nay, and by so doing he immediately records his vote as many times as there are lists of members placed under the points. The marks are very distinct, and the time occupied in the voting is reduced to that necessary for the Clerk of the House to read the names and sum up the votes of the two columns.

It is not within the proper powers of this Committee to decide upon any of the advantages to be derived from this method of rapidly taking the ayes and nays, except that arising from the great economy of time. The others, such as rendering the voting of members more independent, and preventing the resort to the calling of the ayes and nays, as a mere means of delay and vexation, being in their nature political. The Committee therefore confine themselves to the expression of the opinion that the apparatus of Mr. Monaghan fulfils the purpose for which it was intended, by making any number of instantaneous records of the votes. Mr. Monaghen has submitted to the Committee numerous certificates from the members and Clerks of the House of Assembly at Harrisburg, where his apparatus has been erected, that its results were satisfactory.

The apparatus is very simple, not expensive, and easily repaired by an ordinary mechanic, and so far as the Committee know, they have reason to believe is novel. They therefore judge it worthy of approval.

By order of the Committee,

WILLIAM HAMILTON, *Actuary.*

Philadelphia, July 12th, 1849.

BIBLIOGRAPHICAL NOTICES.

Chemical Analysis, Qualitative and Quantitative. By HENRY M. NOAD. *With numerous additions, by* CAMPBELL MORFIT. *With Illustrations, pp.* 572. *Philadelphia, Lindsay & Blakiston.* 1849.

The visible objects around us are not as simple as they appear to be, but with few exceptions are variously compounded of two or more simple or elementary bodies, that is, simple, undecomposable, not resolvable into other bodies, according to the present state of our knowledge; and we have nothing to do with the conjectures as to what future chemists may accomplish. It is the business of the chemist to resolve these compounds into their elements, to show us of which elements and in what proportion they are composed. Now there are 63 elements, of which 20 are in constant use among us, 14 employed to a considerable extent, 7 of trifling importance, and 22 not used at all, as far as we know. Since the properties of a compound are usually very different from those of its constituents, we cannot know by simple inspection what a body is composed of, and to determine its composition is not always, indeed rarely, an easy process.—We must know the properties of each body, the manner in which it behaves to various chemical agents, and by taking advantage of those properties or behavior, in which two elements differ, we may separate them from each other. But these differences are often so slight that the difficulties of separation are by no means as easy as might be imagined. Fortunately most of the bodies we have to deal with contain but few elements, for if we had to decompose a compound containing some 30 of the elements, the best chemist would shrink from the task, unless impelled to it by weighty considerations. But although bodies usually contain but few elements, yet those are variously compounded, and according to their composition the processes of separation are devised. Hence arises the two fold division of *analysis*, or the chemical separation of a compound into its elements, qualitative and quantitative. By the first we determine the number and nature of the elements present, and by the second their relative quantity.

Works on elementary chemistry formerly contained a few pages on analysis, usually stowed away at the end of the work, and it was a mystery to the student to know how it was possible to find out all the facts represented in the body of the work. Now, however, we have many separate treatises on analysis, and among them works of considerable size. Faults they almost all have, for while one is too full, another is not full enough, while one is too scientific for the common reader, another is rather too practi-